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In 1967, the Canadian Council for Research in Education sponsored a symposium on educational media and technology which included educational researchers, communication experts, government officials, and representatives of companies concerned with the development of instructional materials. Goals of the symposium were increased communication among the groups represented, identification of the parameters of educational technology, and identification of pertinent research problems to be investigated. The meeting included discussion groups, panels, and the presentation of some 16 papers. While all areas of technology in education were covered, the greatest emphasis was placed on computers and computer-assisted instruction. The report of the symposium includes resumes of the papers, which cover many dimensions of educational technology: communication theory and application, use and development of new instructional materials, administration of educational facilities, current practices in Canadian schools, and the involvement of educational research, industry, and government. Transcripts of the panel discussions are also included and cover technology and individual differences, the problem of quality in education, future applications of educational media, practical considerations in media use, and the roles of research and development in shaping the new technology. (MT)

Symposium

EDUCATION AND THE NEW TECHNOLOGY

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for Research
in Education

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en éducation

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SYMPOSIUM
EDUCATION AND THE NEW TECHNOLOGY

COLLOQUE
EDUCATION ET TECHNOLOGIE

ED025145

Convened by the Canadian Council for Research in Education

Sous les auspices du Conseil canadien pour la recherche en éducation

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Preface

At the February Executive Meeting of CCRE in 1967, Dr. Moffatt, President, noted that the three main functions of CCRE were to promote research at all levels, assist with research at the national level and cooperate in providing liaison at all levels through the Canadian Education Index, publications and the Annual Conferences. It was agreed that CCRE should experiment with another sort of conference with smaller numbers in a limited area. The topic, "Education and the New Technology", related to a legitimate section of the research field. It was considered an area exhibiting considerable growth and interest. It was thought that the seminar could identify both the parameter of the field and some pertinent related problems for research which might be undertaken by manufacturers and by education researchers. At the same time, consideration might be given to considering appropriate liaison measures between the education research community, companies working in the area, communication experts and government. It was agreed that this was a suitable area in which CCRE could experiment with a new sort of meeting.

The secretariat, after consulting with interested persons, planned to limit the number attending to 100, but including active educators, communication engineers, vocational technical educators, education administrators and anyone developing the new media. Actually, just under 100 attended, made up of 29 per cent from institutes and faculties of education, 29 per cent from other education units and bodies, 21 per cent from government personnel and 21 per cent from industry.

Anyone interested was invited to prepare a paper. Some 25 indicated interest and 18 papers were distributed before the meetings or at the time of registration. Those preparing papers were given five minutes to review their paper. Bibliographical materials were distributed. This was to save time for the five panels and four group discussion sessions lasting at least one hour each.

The Symposium indicated that picking the right topic and selecting the right people is the secret of good meetings. Those who reviewed their papers contributed to the conference, as did the panel members. The discussion groups had to be stopped at the end of the time. Their discussion, although related to the assigned topic, varied widely from group to group. It is too bad these were not taped, since they would probably be of considerable interest. Recorders of the groups were asked to note the high spots.

This Report gives an introduction, a taped record of the panels, short reports of the discussion groups, extracts from the reports, or the full report, if short; and in Appendix II, a list of those attending the Symposium.

On behalf of CCRE I would like to thank all those who cooperated through preparing papers, sitting on or leading panels, directing or recording group sessions, providing films, equipment and advice. Of these, Mr. Hugh Humphreys helped with the planning, Mr. J. Livingston of RCA was responsible for having Dr. Wilson there, Miss Margaret Gayfer prepared a special section in School Progress; others are listed elsewhere in this Report.

INTRODUCTION

Just under one hundred executive and technicians from selected industries and government, and representatives from the academic world, gathered in Ottawa in November 1967 at a Symposium convened to consider Education and the New Technology. All of these education-oriented persons recognized that we are rapidly becoming a computer-assisted society. Many had booked their flights and made reservations by computer and before long will be paying their expense account the same way. All realized that their lives and work would be changed by computers, and had met to consider how the computer could be harnessed to effect improvement in education. It is true that the Symposium had not been designed exclusively to consider computer-assisted instruction, but rather to look at all of the newer as well as the old media. Yet it appeared thatCAI had grasped the imagination of most; with some skeptical of its use and fearing its abuse.

The intent of the Symposium was to explore ways in which technology and science can help to solve the problems inherent in a continual upgrading of Canadian education. It was recognized that changes are in the wind, but felt that through planning, the education community, with the cooperation of industry, can to a great extent determine the direction and impact of these changes, while nipping Edsels in the bud, ensuring that another teaching machine debacle will not occur, and at the same time making sure that Canadian education is not relegated to the backwash as all progressive countries move forward.

It was optimistically hoped that some of the research problems related to communications engineering could be identified and possibly some priorities could be assigned. Related research in the education setting might also be considered. For the time being it would appear that all of this will be left to the determination of individuals, associations and companies, although some lines of communication were developed, and there are efforts being made which could result in a Canadian-designed "Aristotle".

Among those in attendance were instructors and administrators from all facets and levels of education, indicating that the newer media will influence all types of formal and informal education and training, and that already forward-looking personnel are not only interested but many of them are exploring ways and means of using the media to advantage.

The degree of urgency expressed by those from various education sectors, and the pressing problems they mentioned varied rather widely. For example, the tidal wave of population which passed through the lower rungs of the educational ladder is now swelling the ranks of all post-secondary and higher education institutions. At the same time the interest in obtaining something more than secondary education has increased appreciably, as has the expenditure for capital and current costs. Colleges and universities are increasing in number, size and enrolments and class membership in the hundreds is not unknown. As some professors are more interested in research than in teaching, students are more mature and greater freedom of operation is enjoyed by the staff, perhaps we can look for greater changes here than elsewhere and the use of closed circuit TV, films, tapes and other media would seem to be more easily introduced at this than at other levels.

A second likely area is the post-secondary field, where technical institutes and community colleges are carving out their niche and attempting to meet some pressures of society and the business world. A third is the pre-service and in-service area where the scheduling of formal classes is intended to interfere as little as possible with production, and where individual instruction by mechanical means, whether at work or at home, seems desirable and has proven effective.

Some time was given to considering what computers could contribute to education. The most obvious benefits are the sort of things computers have been doing in business for some time, such as inventories, payrolls, etc. But there were more exciting things to report. Purdue University uses the computer to plan new buildings, OISE and American institutes have used computers for designing flexible scheduling systems. Computers will be grading papers, giving tests, providing instruction and taking over a large part of the basic work in counselling. They can be used in updating the curriculum and in determining grade placement of items. All of this presupposes hours upon hours of careful integrated research. Fortunately computers have already cut the time for data processing and lifted the ceiling on numbers and computations.

Education, Canada's largest industry, lacks the sound research bank of tested ideas and evaluation information considered adequate to meet the demands which will presently confront it. In part this is because there has not been general acceptance that R & D are as necessary and can contribute as much to education as they do to agriculture, health and welfare, space development, etc. In part, because the education field is broad and complex and does not lend itself to simple scientific treatment, we have been slow in attacking the complex of problems systemtatically. This is not the place to discuss the education research structure in Canada, a format which is undergoing growth and change, except to point out that expansion and development are necessary if the problems related to automated education are not to receive short shrift.

R & D, related to the use of the newer as well as the older media, can be categorized as: (1) basic research information, particularly in the fields of communication and learning theory with findings coming from a variety of other disciplines in addition to education; (2) technically-based research concerned with design, efficiency of operation and such, but with a view to producing hardware designed to reach education goals set with consideration of basic research findings; (3) research to develop programs for the hardware (this latter can consist of films, tapes, programmed courses, etc.); and (4) research in the school unit to determine how best to introduce the new equipment and to evaluate it. In addition there may be product research to provide consumers with information needed for decisions regarding purchase, use and such, for both hardware and software.

There was some awareness on the part of educators of what the advent of big business into the education field might mean. It was recognized that the amalgamation of large companies would result in large and reputable firms capable of producing both the hardware and software to go with them. Close coordination in the development of software and hardware is most desirable -- from the beginning they should be designed and made to work together. But this does concentrate power.

The new business moguls are now capable of developing educational systems on a scale hitherto not dreamed of in education. These systems can be prepared and offered as package deals which in turn can be serviced. In addition systems engineers could be used to debug them. Certainly all educators need be concerned about the possible impact of "big" business on education, but should look upon it not as an impending threat, but as a possible answer to some of our problems if properly harnessed. Our objective should be to develop a new educational technology cooperatively, designed to effect changes set out by educators and to help in evaluating success in achieving goals agreed on.

There is need to bring together, in one place, basic information on all of the new technological devices and systems being mentioned in the news; to develop guidelines for teachers and school administrators so that they can prepare themselves for the coming of automated education and fit the contribution which the new technology can make into a systematic approach which will retain much of the good from the old and supplement it with new approaches. This is not an extreme view. It falls between that of those who consider the challenge of technology as a fad to be fought; and those who wish to produce teacher-proof instruction, for use whether at home, in the new libraries or in new educational institutions. It assumes that though the new is not a panacea, it has something to offer so that the new education offerings will be better -- but that the education world will not suddenly become mechanized.

It was a free-wheeling symposium in which divergent viewpoints were put forward, lively discussion occurred, and the flow of conversation ranged all over the field, including the rapid growth of technology, its possible impact on schools at all levels and what can be done to help the schools select wisely and assimilate the new media into a changing program. It was interesting to see that there was comparatively little problem in communication among the educators, business and government personnel and a good deal of similarity of views. A considerable degree of acquiescence seemed evident for the following ten items:

1. Computer-assisted instruction (CAI) is in an experimental stage. It has already indicated possibilities for all levels and types of education and training, but it will be years before its use becomes widespread. To perfect it will require the expenditure of fantastic amounts of money and the time of innumerable professionals and technicians. Development of the software is perhaps a greater challenge than developing the hardware.

2. Although the provincial governments, foundations and industry probably will and should contribute appreciable sums, the bulk of the money will likely have to come from the Federal Government.

3. The role of CAI will not be to replace other media, harness them, or to take over all instruction. Rather, the purpose will be to ensure that all promising media are incorporated and used to advantage. It will not be expected to reinforce curiosity, promote creativity or develop interpersonal relationships, though it can record how well teachers are accomplishing this. It is likely that at best CAI will be used for perhaps half an hour of a student's time per day as a beginning and gradually increased up to an hour and a half. Expansion may be greater out of school than in it for many years.

4. The role of the teacher is changing and, like the modern housewife, will move out of the craftsman stage. Teachers will need new competencies and technical assistants will be added to the staff. Teacher education will have to be updated so that teachers will be prepared to feel at home in the new schools. Actually, a completely new education of teachers and administrators seems necessary if they are to cope with the selection, use and evaluation of computer input materials and other media.

5. Emphasis will be on breaking the "lock step" type of education adapted for administrative ease and the stressing of individual differences in speed, depth, interest and aptitudes. Creativity, power and flexibility will be stressed and the new media should help make this possible. The optimal role of the computer in this must be discovered.

6. The need for research of all types and for all situations mounts. Basic research on the learning process and communication is the foundation of good decisions on curricula selection and allocation. Applied research is necessary if new discoveries are to be institutionalized. Program research on a continuing basis by all units must be undertaken to ensure improvement, and planning is more necessary today than ever before.

7. Information requirements which cut across all aspects of educational research and development require a modern sophisticated system for information storage, retrieval and dissemination. A corollary to this is to provide information on the specifications, critical characteristics and actual performance of educational products.

8. The systems approach which can be viewed as "logic design" for education can contribute by providing bench marks for determining efficiency in organization and removing bottlenecks. Possibilities of adopting a more systematic approach to a greater extent than found at present should be explored.

9. The purpose of effecting changes should no more be to regiment or mechanize education than modern home technology is aimed at sustenance pills, canned exercise and a house that runs itself and determines the behavior of the occupants. Educators have a responsibility to see that schools are operated to provide a liberalizing education while meeting the needs of the individual and of society. Fortunately a compromise can be reached where necessary so that the individual and the group can be reasonably well satisfied.

10. Most equipment is in the horseless carriage stage and the accompanying programs are adaptations of one-teacher classrooms with standard-type courses, questioning and examinations. Two major changes in education have been in progress for some time; the first relates to subject matter, the second relates to methods. Add to these the impending impact of a variety of media and gadgetry and one can hazard a guess at the image of modern education -- the form and content have yet to be determined.

Discussions in the Group Sessions

As one publisher remarked, "The most obvious result of the conference appeared to be the emergence of a need for a clearing house to coordinate the efforts of industry and education in developing instructional materials". There was general agreement in this, but as it had been decided that the purpose of the conference was not to present resolutions, no resolution to that effect was forthcoming. Such a resolution would have had to be directed back at those attending the Symposium and their associations, etc. Ideally such a clearing house should be a cooperative venture.

There seemed little argument that the groups favoured individualized instruction. A majority were of the opinion that technology could be harnessed to assist in this; but such would not necessarily follow. In fact the introduction of regimentation and conditioning was considered to be a real possibility for technology. Nor does allowing youth to progress at their own pace with the same materials meet the demands for variety. CAI in the long run might provide a partial solution, but its extensive use seemed a long way off. It was felt that we cannot afford to sit in wait until CAI has developed and its coverage made universal. Rather, we must press on with independent study, the ungraded school, team teaching and other expedients, many of which may later be incorporated into one or more systems.

Quality control was discussed. Many thought this was the business of central agencies who would conduct research, delegate it, or contract to have it done. They would publicize the results, devise standards which would be passed down or imposed on the various units. Some questioned the top-down approach which, if used to any extent, could work against unstructured, discovery approaches to learning, and innovations designed to individualize instruction. This matter was aired but not resolved. No answer will be found overnight, and no simple solution should be expected. Perhaps a middle ground would be preferable; one in which we provide for a balanced program of research and innovation organized at the top but with plenty of elbow room at the bottom where the children are educated. This would not be aimed at producing a uniformly acceptable product but at excellence in variety.

The situation in which private firms are competing for the education market was deplored by few, although there were the usual valid complaints against monopoly, fly-by-night manufacturers, high pressure advertising, exaggerated or false claims and such. But, generally, reputable firms were commended for so often taking the initiative and filling recognized needs. One would be naive indeed to expect perfect agreement as to the best procedures, and this would be most undesirable at this time. But a willingness to look at the problems together represents a big step in the right direction. Few suggested that the education community take over, only that communication be established.

There was considerable discussion about aims and the philosophy of education, but once more the situation was left unresolved. This is not to suggest that the exercise wasn't worthwhile. It was felt that the education community must reach more general agreement as to what we are setting out to do in education. It should not be necessary to get bogged down in theory to do this, nor should we accept too readily behavioral objectives without evaluating the results of their adoption in the broad context.

The proliferation of materials and techniques, a situation bound to grow and increase problems of selection, would seem to make it necessary for education to set up its own standards and possibly employ specialists. It should require the producers of materials to substantiate their claims with evidence of validity, field testing, etc. Reputable firms are doing this and would probably welcome education's insistence that all competing firms be expected to follow suit. At the same time there is need for field trials which might be undertaken cooperatively by industry and education. Assessment is necessary, whether one is considering a product system or the incorporating of a single instrument into the regular school program.

Assessment was considered and there were suggestions that cost-benefit analysis be used. Some felt that cost-benefit analysis must be predicted upon some total system values. This raised the problem as to whether these should be economic, social, cultural or some combination of these. Until this is settled we are at an impasse. Some raised the question of the transitoriness of aims; and while it was admitted that this was true at least for immediate aims, there was a general feeling that you have to have a destination in mind before you set out on a journey. In education, it is not enough just to go for a walk.

Teacher education was mulled over and among other things it was noted that the artificial credential method by which our society functions and closed shop unionism stood in the way of teachers and industrialists swapping jobs temporarily. Teacher training should probably be extended so that teachers could develop a philosophy of education. The use of para-professionals was considered and the question as to whether or not teachers were absolutely necessary was raised. It was pointed out that much of what teachers now do could be done equally well by machines, or teaching assistants, or left undone. It is interesting that a question relating to the need for teachers comes after similar questions have been mooted relating to school boards and to school superintendents. Few either saw teachers leaving the scene, or wanted this to happen, but they would not defend teachers doing what machines can do better. To them the teacher of the future must stimulate independent study, be a decision-maker, diagnostician and remediator, a professional, not a technician.

It was suggested that the attitude of many teachers is not conducive to innovation or to the use of the newer media. Internship was considered to be a good means of maintaining the status quo. We are not as yet sending teachers out to work, competent to make use of what is presently available, nor ensuring that those in the field keep up to date with the latest gadgetry and methods as is done in medicine.

There is great need for educators to make known what is wanted and for some control organization to evaluate the offerings of industry. The Council of Ministers could accept responsibility for seeing that they, or better some independent organization, provide the services required but with their support.

It was also thought that because of the education world's interest in the potential for educational technology the Provincial Ministers of Education should consider seriously the creation of inter-disciplinary, applied research centres in education technology.

One group, in considering this matter, suggested that since it was generally recognized that there was a great variety of materials displayed on the market at present, and the variety would probably increase considerably, the Departments of Education should take the initiative and responsibility for ensuring that research be undertaken to establish criteria for standards and the utilization of the newer media. It was pointed out that many of these materials had been devised for other purposes and might have to be modified for efficient school implementation, and many of them had not been field-tested in school systems.

As teachers and teachers in training need special knowledge of the technology as applied to education, there was general agreement that local and regional structures should be designed so that educators would have first hand knowledge and become thoroughly acquainted with the newer media in the schools.

Since the universities play a major role in the preparation of personnel who will use the new technology, it was recommended that the universities be given every encouragement in providing courses for people who will use the newer media, find new uses for it, test it in the field and evaluate its possible contribution.

Other suggestions related to CCRE holding other symposia in the field. Several proposals were made for future meetings. One was that greater use be made of the newer media in subsequent conferences; another, that these should be directed towards providing for intercommunication of French-speaking and English-speaking personnel, the conduct of bilingual sessions, and the use of closed circuit television instead of instantaneous translation with receivers as commonly used today. It was also noted that classes or youths might be invited and that demonstration sessions might be valuable.

Another suggestion had to do with the formation of a Canadian "Aristotle" (Annual Review and Information Symposium on the Technology of Training, Learning and Education). History of this organization in the United States is not long but interesting.

Success in the application of new technology and the discipline of systems analysis in the development and procurement of new weapons systems suggested that these might have application in the field of education. To stimulate thought and action along these lines, the U.S. Department of Defence, Office of Education and Department of Labour sponsored a conference in June 1966. Proceedings of the meetings are reported in "Engineering Systems for Education and Training".

A volunteer organization, under the administration of the National Security Industrial Association, was founded to provide a structure to encourage continuing communication within the Government/Education/Industry community. Its ten task forces of 250 volunteers are expected to contribute to the advancement of quality and efficiency in education.

Canadians are presently considering whether or not there is need for some such organization in Canada. It is not likely that either the history or pattern will follow that of the American "Aristotle". Canadians must work within their context including the BNA Act, the present structures for education and training and the associations already working in the field of education.

The work may be parcelled up among existing associations and institutions and advisory and working committees may be set up, or a whole new organization may be required with task forces, committees, etc.

The Symposium served to identify several needs which are currently not met in Canada, such as:

1. The establishment of lines of communication joining those interested in automated education throughout the Government/Education/Industry community.

2. A system of information collection, storage, retrieval and dissemination covering research, innovations, projects in automated education, and statistical data.

3. To provide clearing house functions for those in education including dissemination of information on media specifications and use, innovations in education, expertise available, etc.

4. To provide communication at the technical level among the producers and consumers of technical hardware and software, but especially for those undertaking research with the newer media.

5. Exploration concerning the possible use of a systems approach in a variety of different educational situations.

6. The setting up of experimental units, some of which would use a system of instruction such as CAI complexes for some part of the school day.

Group One was bilingual and much of its discussion was conducted in French. Dr. Antonio LeSieur provided the following summary:

1. Le monde de l'éducation doit accepter et exploiter la technologie comme un trait nouveau de notre culture et un moyen inévitable d'améliorer l'éducation elle-même.

2. L'adoption de la technologie en éducation remet en question la formation des maîtres en exercice et en préparation, les programmes de formation, les méthodes d'enseignement et le conditionnement des locaux scolaires.

3. La technologie appliquée à l'éducation tend à une individualisation marquée de l'enseignement et va à l'encontre du mouvement de socialisation que, pourtant, tout le monde semble accepter et prôner.

4. Les mondes de l'éducation et de l'industrie technologique doivent se rapprocher pour mieux comprendre les problèmes d'apprentissage et de communication et chercher à s'adapter le mieux possible aux exigences de l'éducation actuelle.

5. La difficulté d'acclimatation de la technologie actuelle au monde de l'éducation vient surtout de l'imprécision des objectifs et du contenu des programmes actuels d'enseignement que les responsables de l'éducation devraient chercher à préciser davantage.

6. Les experts de l'éducation et de la technologie devraient chercher à préciser ce que la technologie peut apporter au monde de l'éducation et qui pourrait permettre d'alléger les programmes, d'activer l'enseignement et de mieux préparer les individus à leur carrière future.

EVALUATION OF TWO EXPERIMENTAL CAI SYSTEMS AT STANFORD*

Dr. H.A. Wilson of the Institute for Mathematical Studies in the Social Sciences of Stanford University got the Symposium off to a fine start with his keynote talk on two projects currently being undertaken in the field of Computer-Assisted Instruction at Stanford University. The following notes are what one listener got from his presentation.

CAI can provide a variety of programs with varying degrees of complexity. It is relatively easy to put a linear program prepared for a "teaching machine" on the computer, but it will be no better on the computer than on a simple hand-operated machine. Dr. Wilson recognized three main levels of CAI, all of which perform valuable services if properly used. The lines of demarcation between these levels is based primarily on the complexity and sophistication of the student-system interaction rather than on the hardware and software used. The lowest or basic interaction level provides a linear program made up of problems. When students make errors, the prompt may be a partial or the whole answer, but there is no selection from a variety of other materials according to the response. These are "drill-and-practice" systems and were used in arithmetic and spelling at Stanford.

The second level is classed as "tutorial" and is a branching procedure in which the student is able to follow separate and diverse paths throughout the curricular offering accordingly as he responds to each step in the program. The variety of paths depends on the ingenuity of the programmer, but the number of permutations and combinations is large. However, in responding to the items, the student is restricted to choosing from a prescribed set of responses. This procedure is used by Stanford for initial reading and elementary mathematics.

In the upper level of CAI programs we find the "dialogue" type which aims to provide student-system interaction in which the student is free to use natural-language responses, ask questions and generally to treat the system as a cooperating agency in learning progress.

One, the Palo Alto experimental study, began in Brentwood School in East Palo Alto, California in 1966. It was designed to determine how well elementary school pupils learn to read and to do arithmetic problems when their regular human teacher, with all the warmth and frailties generally associated with teachers, is replaced by a well-staged education program complete with human voice, television screen, light pencil and typewriter keyboard and at the same time, impersonal, patient and persistent. Each child spends only about 20 minutes each day with the computer; and generally they are so intrigued they wish to continue longer. For the rest of the day, they participate in the regular school program.

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*Report will be published as the work advances.

There are 100 school entrants involved as one unit in this project. For the reading program, half are taught by computers, the other half by conventional methods. For the arithmetic half of the project the control group use the computers and the experimental group in reading become the control group. Brentwood, where this project is conducted, can be described as a slum area with an 80 per cent Negro enrolment. The average I.Q. is probably around 89 and the pupils would be considered as disadvantaged. Results look promising, but it is too early for evaluation.

The Stanford system uses a modified PDP-1 computer and Model 33 Teletype units for the student-systems outlets. The program is expanding. In 1965 one terminal processed some 41 students per day. The program has grown and for 1967-68 there are 83 terminals spread into several states and processes up to 1000 students in a single day.

In the Arithmetic Drill and Practice section of the program, daily lessons with various degrees of difficulty have been given according to how well the student did on the previous assignment, and review exercises, with additional practice where necessary, were given at two to four week intervals. Pretests determined the sequence and difficulty level of blocks of subject matter and posttests determine the level of difficulty of subsequent blocks. Thus individualization of instruction is provided through the sequence of blocks of subject matter programmed for each student. Students determine their rate of speed and reinforcement is provided after each response. The computer provides an evaluation sheet of all students for the teachers both daily and at the completion of each block.

Results of the drill-practice experiment would appear to be encouraging, but it will be some time before a definitive report is available.

The Tutorial Program

In this, the second program which is conducted in a special Stanford-Brentwood laboratory building, each student has available a special typewriter keyboard, a light pen, a film projection choice, a set of earphones and attached microphone and a television screen for black and white or colour. The system provides for a processor-controller, audio control unit, magnetic tape unit, disc storage, card punch and reader and printer. Two proctor stations and 16 student stations complete the present assembly. This is basically an experimental set-up aimed at d-bugging, and various programs have been tested out. To date the students in the CAI group appear to be doing better than the control group in many tests. However, it is too soon to assess the situation. There is also some interesting information on rate of progress, but this relates only to minimal exposure. Evaluation for longer exposure daily periods will have to wait further research.

An interesting finding of the program is that with a good CAI program the differences between the poorer and better students increase during the year, a situation other experimental evidence has shown to be necessary if each is working anywhere near capacity. Goals of education should not be aimed at having everybody reach an acceptable standard as much as having each one develop according to his potential.

The suggestion that sex differences in reading accomplishment favoring girls can be explained by the social organization of the classroom or differential rates of growth has been considered. Evidence to date from the CAI programs suggests that there are no basic differences in scholastic ability between the sexes. This should not be interpreted to mean there are no sex differences. While it is much too early to provide definitive conclusions, the experimental evidence from CAI programs to date would suggest the possibility of determining to a reasonable degree of certainty many problems providing conflicting evidence to date.

THE NEED FOR INCREASED COORDINATION AND COOPERATION IN EDUCATIONAL RESEARCH

by
Colin A. Billowes
Northern Electric

The emergence of educational technology as a major business has shown up serious weaknesses in the communications between the three main interested parties -- education, government and industry. The fact is well known and was a probable outcome of the marrying of many disciplines under a new umbrella.

This marriage is not a temporary one and therefore there is ample justification for significant effort on solving some of these communication problems. Failure to do so will lead to the teaching machine type debacle many times over.

The present interdisciplinary dialogue is very much on an ad hoc basis, with an increasing number of journals devoting their attention to the area of educational technology. Annual conventions, sponsored by various professional and learned societies, are on the increase, with the addition of the "old boy" and "grape vine" networks comprising much of the interdisciplinary communication in the area of educational technology.

This is obviously quite inadequate and more effort is needed to create a forum capable of promoting self-sustaining continuous interdisciplinary dialogue among all parties and at all levels.

In the U.S.A., project Aristotle is attempting to promote this continuity by the formation of study groups of interested people and organizations from industry, government and education. This type of organization seems a most promising formula, and something which we could well use in Canada. A similar organization would certainly be an asset in this country at this time, especially in view of some of these recent developments:

1. The National Research Council has reformed one of its electronic technology groups into an educational technology research department.
2. The Ontario Institute for Studies in Education is becoming a force to be recognized in the land.
3. The Canadian Council of Ministers of Education has just been formed following the Interprovincial Conference on Education held in September 1967.
4. The Federal Department of Manpower has formed the Pilot Projects Branch to develop and evaluate new ways and means of improving manpower, training and retraining especially in economically depressed areas.
5. Many universities, school boards, government departments, industrial organizations and others are sponsoring or initiating their own research and development projects.

It is no simple problem, however, to devise a working formula which will lead to the desired synergistic effect of all these splinter group efforts.

It might be helpful to identify some of the following important factors to be considered in the formation of such an organization:

1. The organization must have no vested interest, either political or industrial, for it is important -- indeed vital -- that all the interested disciplines in this area have confidence in the respectability of the proposed organization.

2. Early leadership must be dynamic, for if the organization does not show itself to be worth its cost and effort of participation, it will rapidly become sterile. Indeed, there is some wisdom in the notion of controlling the membership in a manner to ensure active participation.

3. Participation must be of a year-round nature, not simply limited to short bursts of activity once a year. This is not easy to achieve and obviously some form of journal is needed for the speedy dissemination of news and information.

4. The organization must be given the opportunity of making its influence felt. If, for example, a strong consensus develops among its members, some way must be found of ensuring that serious and active consideration is given to its thinking. To this end, consideration should be given to assigning the organization some sort of official advisory function, perhaps to the Canadian Council of Ministers of Education.

Other important factors will undoubtedly come to mind which will be critical in the embryo stages of such an organization.

This proposal amounts to a suggestion for the formation of a new learned society with perhaps some unusual characteristics. Entry qualifications would be based less on academic prowess but more on ability to contribute. Membership could be on a corporate, institutional and individual basis.

The organization might be best operated independently or perhaps under the auspices of the CCRE or the new Canadian Council of Ministers of Education. Perhaps the CCRE should consider a transmutation to this type of organization.

It has been the intention of this paper to point out the urgent need for increased communications in educational technology. There is a real urgency here.

Both the author and his employers, the Northern Electric Company, would be glad to play an active part in spearheading an effort of this nature.

PROJECT ARISTOTLE

The National Security Industrial Association (NSIA) has organized a joint Government/Industry/Education training and education project which has been designated Project ARISTOTLE, standing for:

Annual
Review and
Information
Symposium on the
Technology
Of
Training,
Learning, and
Education

The project is sponsored by NSIA and supported by the Department of Defense, the Office of Education and others.

The objective of the project is to provide a structure to encourage continuing communication and exchange of accomplishments within the Government/Industry/Education community and contribute to the advancement of quality and efficiency of the nation's education and training. This will be accomplished through cooperative task groups formed from members of industry, government, national associations, and academic groups.

Ten task groups have been established as follows:

Task Group No. 1 - Project 100,000 Training
Task Group No. 2 - Media
Task Group No. 3 - Information Storage, Retrieval and Dissemination
Task Group No. 4 - Educational Research
Task Group No. 5 - New Developments
Task Group No. 6 - Systems Approach to Education
Task Group No. 7 - Standards, Measurements and Evaluation
Task Group No. 8 - Courses, Tasks and Skills
Task Group No. 9 - Government/Education/Industry Interface
Task Group No. 10 - International Considerations

Much of the current effort of these task groups is being directed towards the First Annual ARISTOTLE Symposium to be held December 6 - 7 at the Washington Hilton Hotel in Washington, D.C.

Further information on the project may be obtained from NSIA Headquarters as follows:

Project ARISTOTLE
Attention: Norman E. Rogers
National Security Industrial Association
1030 15th Street, N.W.
Washington, D.C. 20005

DEVELOPMENT OF A COMPUTER-AIDED TEACHING SYSTEM (Abstract)

by
J.W. Brahan and W.C. Brown
National Research Council

Introduction

As automation of industry is introduced and productivity rises, there will be an increase in available leisure time and the demand for adult education programs can be expected to grow as automation spreads. Industries also have a growing requirement for more efficient training facilities within their own organizations. Teaching machines and programmed texts in general do not provide facilities for the preparation or modification of course material. They can result in a heavy administrative load being placed on the teacher, who must compile records for a large group of students each progressing at his own rate.

The Program at the National Research Council

In the Radio and Electrical Engineering Division of the National Research Council, an investigation of the application of the computer as an aid to teaching has been started. The program will include the assessment, and subsequent design where necessary, of the input and output equipment, information storage and retrieval methods, and the systems programming required to make computer-aided teaching effective at all educational levels. It should be clearly understood that our plans include no work on curriculum content -- that is strictly a matter for the educational authorities.

Initial System Configuration

Several years ago, a special-purpose digital computer with limited input-output facilities was designed and constructed in the laboratory. Its input-output and storage capabilities have recently been expanded and it will be used as the basis of the system for the initial investigation. The general organization of the system presently being assembled is shown in block diagram form in Fig. 1. Those blocks in the diagram which are heavily outlined are in service, the other units are under construction. The main computer has a sufficiently powerful command structure to cope with the required information processing, but its speed severely limits its application to the problem of sampling a number of low-data-rate terminals. Hence a small high speed computer (A Digital Equipment Corporation PDP-8) is used as a buffer store between the main computer and the student terminals to sample each of the terminals, to arrange messages in a standard format, and to permit an efficient transfer of information to and from the main computer. The initial student terminals included in the basic system will consist of three teletypewriters, a cathode ray tube display, and a film projection display, each with facilities for keyboard input.

Lesson Preparation and Presentation

The initial control program is being written using the teletypwriter terminals as the input-output devices. This will later be expanded to include the other input-output facilities as they are added to the system. The instructional material is divided into blocks which have been called "lessons". Each lesson consists of a number of items which may be statements, alternate statements, questions, answers, and error messages. Statements and alternate statements are used for presenting information to the student and require no response to be made. Alternate statements are presented only if it appears from the student's response(s) to the question(s) that the original statement has not been understood. With each question, a number of possible answers may be entered, at least one of which must be designated a correct answer. Each answer must contain a reference to an error message which will be presented to the student when his response matches that answer. Thus the system will be capable of recognizing common errors as well as correct responses and the necessary remedial action can be taken. During the presentation of the lesson, responses which are not contained in the list of answers will be recorded for future analysis. This will permit the author to add to the answer list common responses which were originally neglected. Provision is made for the author to write or modify a lesson from any of the teletype terminals, whether or not the other terminals are being used. Items may be added to the end of a lesson, inserted within the lesson, or deleted entirely. In entering course material into the system, or modifying material already entered, the author does not make use of the basic computer command structure. A special set of commands are available to him to facilitate writing and editing course programs. These commands include:

CALL:	The system locates the lesson or item specified and the next operation affects that lesson or item.
DELETE:	This permits any item within a lesson to be eliminated. If the item is a statement, then all alternate statements and questions and answers based on that statement will be deleted. Similarly if the item is a question, all answers associated with the question will be deleted along with the question.
MODIFY:	This permits the author to replace any item within the lesson with a different item of the same type.
ADD:	This permits an item or series of items to be inserted within the lesson or at the end of the lesson.

Two modes of operation will be possible with the system. The mode must be specified by the author at the beginning of the lesson, and it remains fixed throughout the lesson. The first mode presents information to the student in essentially a linear flow. This is illustrated in Fg. 2. In this method of operation, one set of questions and answers is used for a statement and a number of alternate statements. If an error is made in answering a key question, or if the error rate is higher than a specified criterion, the student will be branched back to a remedial alternate statement and then led through the same series of questions.

The second mode of operation permits a number of parallel paths through the lesson as illustrated in Fig. 3. In this case, branching can take place to an alternate statement at a lower level at the end of any question or at the end of a series of questions. The initial system configuration will return the student to the highest level each time he is directed to a new statement. Consideration will be given later to the development of a decision structure which will permit paths through the lesson entirely at lower levels, based on the system's assessment of the particular student's ability.

It is recognized that the initial system configuration has many limitations. However, the main purpose of developing the initial system is to gain an understanding of the problems involved in a time-sharing system suitable for computer-aided teaching and to use this knowledge to develop a more versatile system. The system described should be in operation using the three teletypewriter terminals late this year.

Current Related Developments

One of the areas where much work remains to be done is in the field of display-response equipment. For a computer-aided teaching system to be effective, there must be very close coupling between the student and the subject matter; the terminal hardware should be easy to use and not require a great deal of skill to operate so that it does not distract the student's attention from the lesson content. While the typewriter is a convenient device for use as a computer input-output mechanism, it is noisy, and is subject to mechanical and electrical failure. It is particularly unsuited to the teaching of young children who could not be expected to compose a response of much more than one or two characters using the keyboard. Further, the noise problem can become quite serious if a number of terminals are being used in one room.

At the moment, work is in progress on a number of developments related to the field of student terminals for computer-aided teaching systems. An experimental alphanumeric display has been developed and tested. It includes a facility for the presentation of graphical information as well as text material. The interface circuits to control this display are approaching completion. An input mechanism is being sought that will allow a student to communicate his answer to the computer merely by placing his finger on the appropriate point on the cathode ray tube display. Results so far achieved indicate that pulsed ultrasonic surface waves in glass can be used successfully for this purpose. No wires are needed. The energy is reflected by the finger in contact with the Cathode Ray Tube overlay, and timing circuits similar to those of radar establish the position in rectangular coordinates. Such an input device would permit composition of complex messages by designation of special "keyboards" on the face of the CRT, or complete statements could be addressed directly without keying. The "pointing" feature would provide a most natural input device, particularly for young children.

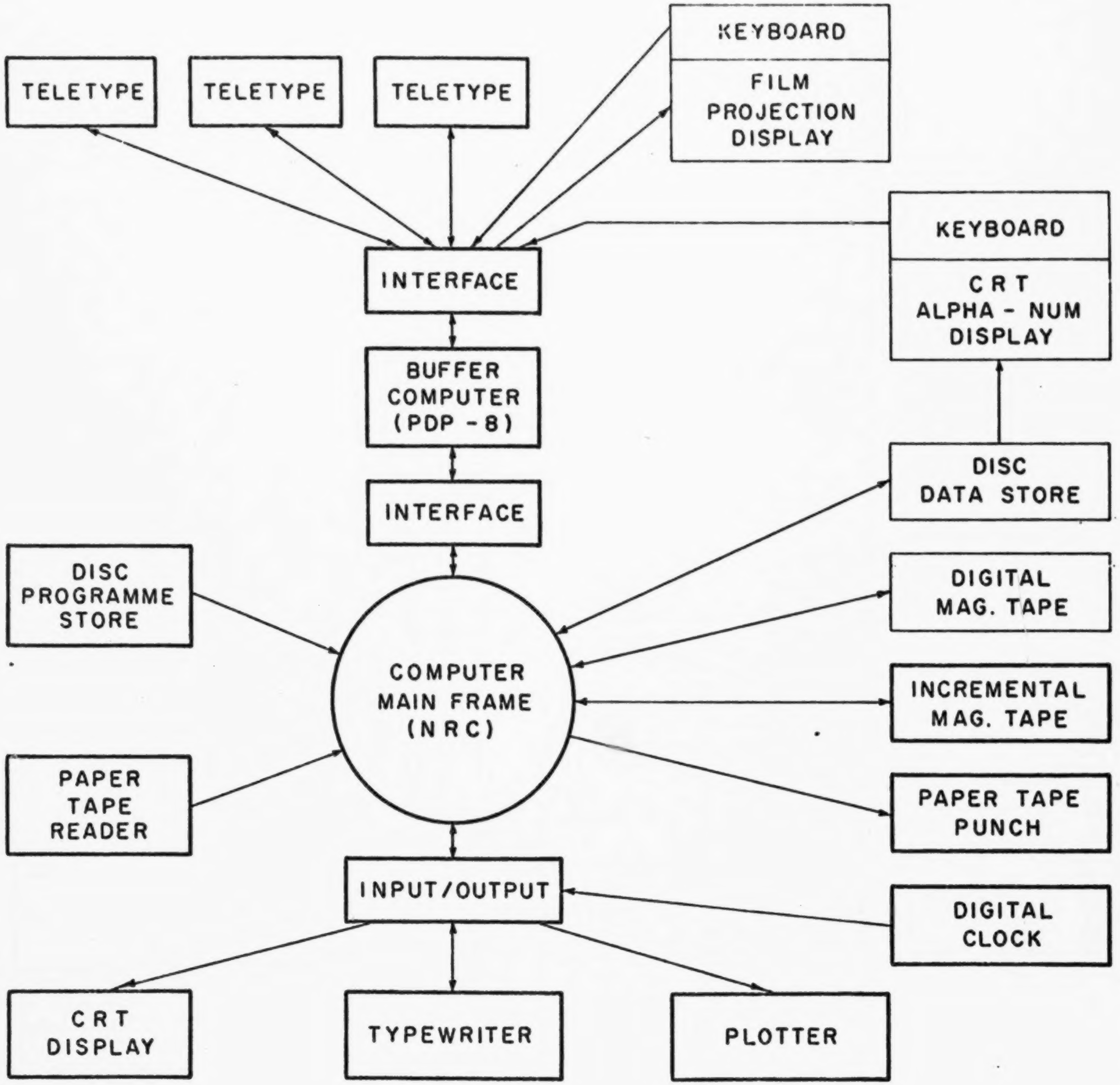
Modifications to the Autotutor, a programmed film reader, and to a conventional television tape recorder are being considered to permit them to be controlled automatically by digital computer. An indexing system for a multi-channel audio tape recorder is under development which would permit audio information to be presented to the student to supplement the visual presentation.

Future Program

Based on the results obtained from the initial investigation utilizing the configuration outlined above, a system will be developed incorporating a larger central computer with more extensive storage facilities, which will permit much more comprehensive experiments to be carried out. Efforts will be concentrated in the areas of development of terminal equipment, development of specialized computer facilities such as random access audio and video storage capabilities, and the development of control programs to provide a system which effectively communicates with the student and which can be used effectively by the teacher in preparing instructional programs and monitoring and updating their presentation. During this program, very close contact will be required with educational authorities in order that the requirements of the educator can be incorporated and the effectiveness of the system fully assessed.

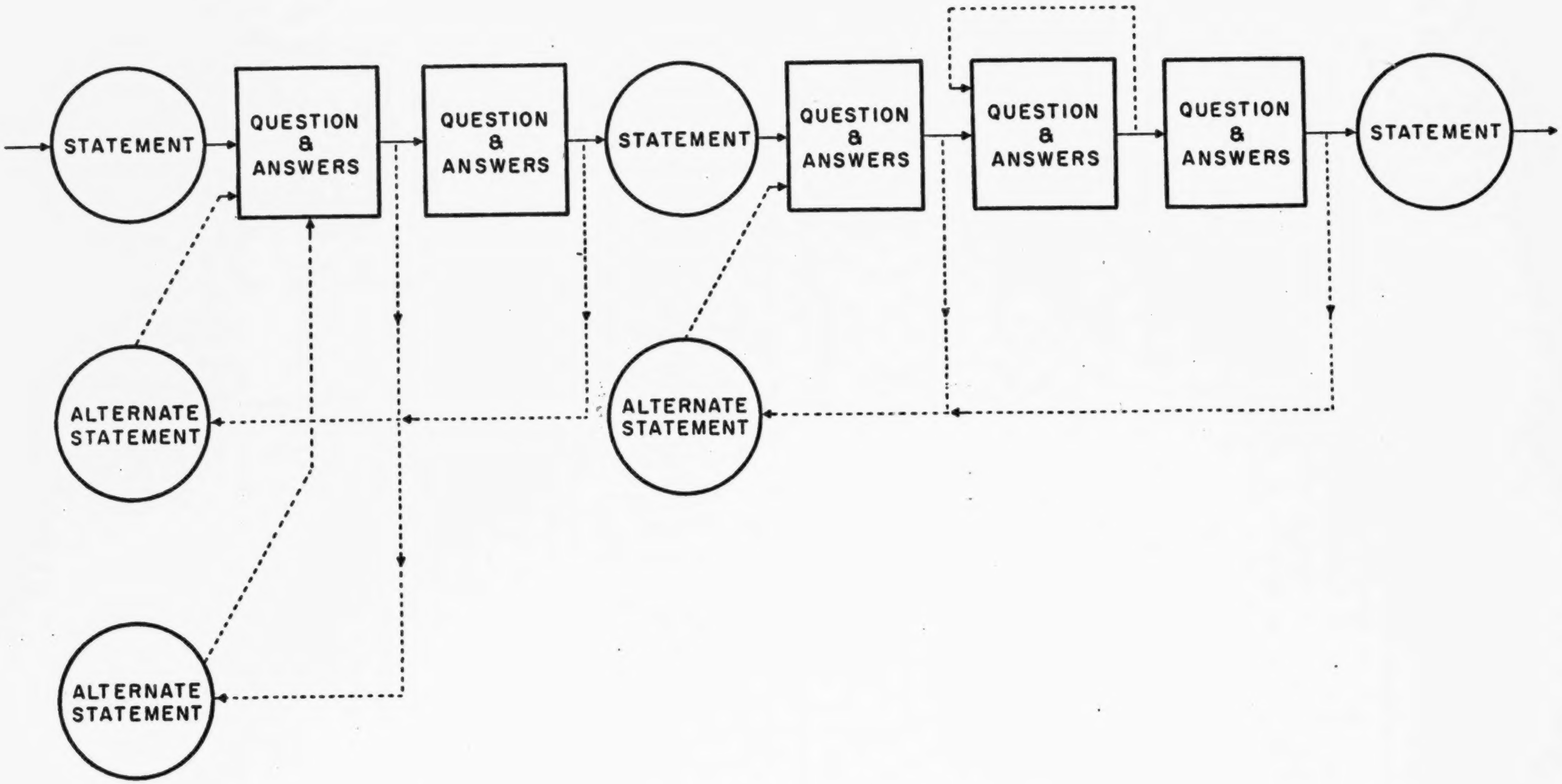
Conclusions

The program which has been started at the National Research Council will not be a short one. The value of many individual components of computer-aided teaching systems has been demonstrated, but many problems remain to be solved before computer-aided systems can be considered to be truly effective. The integration of these components, the programming, and the improvement in the input-output terminals will require a major effort over a period of years. In addition, the educator will be faced with the problem of determining how much of the student's time should be devoted to computer-aided teaching, and how this new technique should be integrated with existing teaching methods. During this time, close cooperation will be required between the educator, the psychologist, and the technologist if an effective development is to be achieved.


TELETYPE
TELETYPE
TELETYPE
KEYBOARD
FILM PROJECTION DISPLAY
KEYBOARD
CRT ALPHA - NUM DISPLAY
INTERFACE
BUFFER COMPUTER (PDP - 8)
INTERFACE
DISC DATA STORE
DISC PROGRAMME STORE
COMPUTER MAIN FRAME (NRC)
DIGITAL MAG. TAPE
INCREMENTAL MAG. TAPE
PAPER TAPE READER
PAPER TAPE PUNCH
INPUT/OUTPUT
DIGITAL CLOCK
CRT DISPLAY
TYPEWRITER
PLOTTER

INITIAL CONFIGURATION FOR INVESTIGATION OF COMPUTER - ASSISTED INSTRUCTION

Fig. 1


STATEMENT
QUESTION & ANSWERS
QUESTION & ANSWERS
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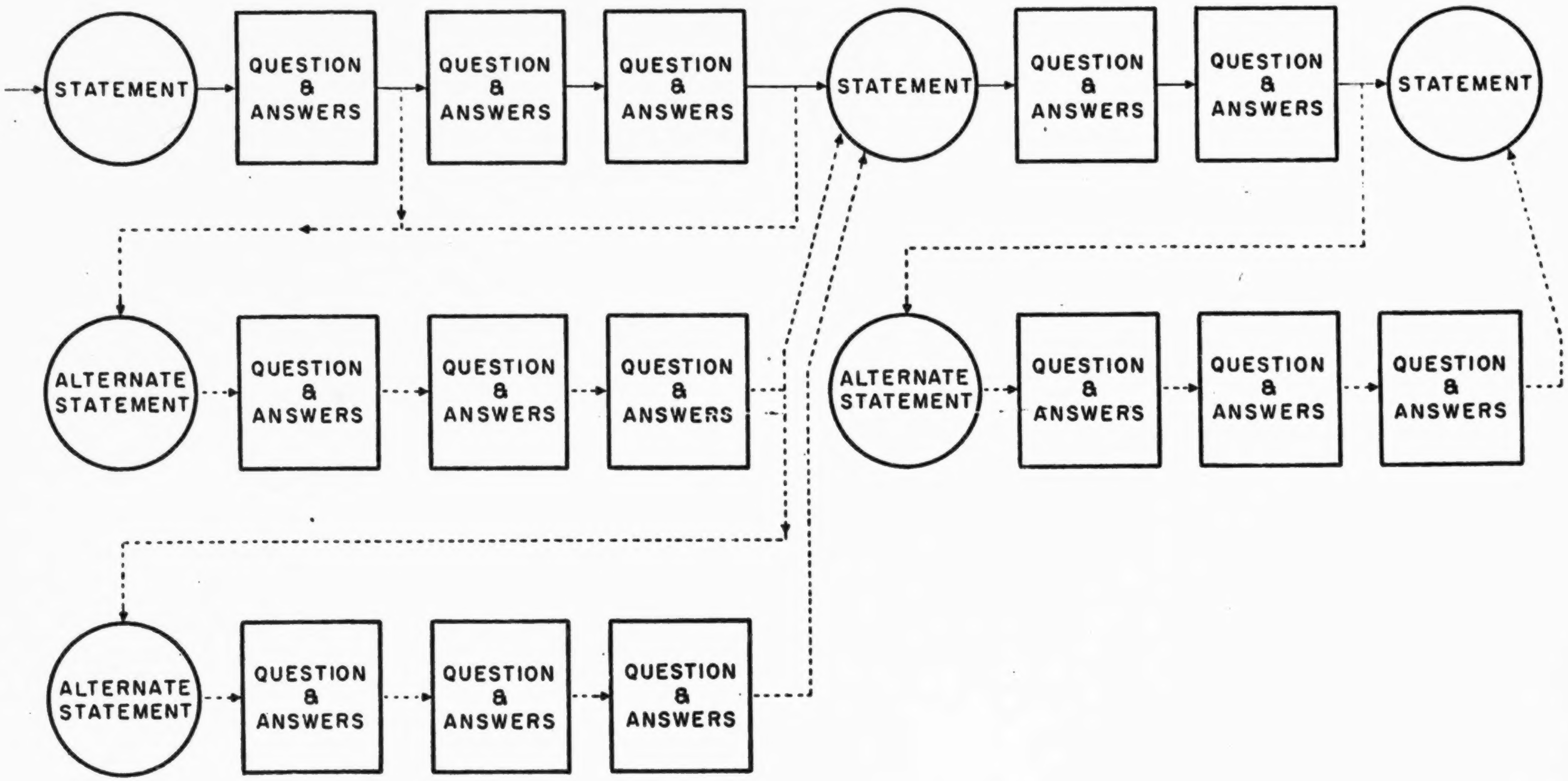
LINEAR PRESENTATION MODE

Fig. 2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PARALLEL PATH PRESENTATION MODE

Fig. 3

INSTRUCTIONAL MATERIALS

by
William L. Darnell
McGraw Hill

An analysis of the diverse offerings within the instructional materials market reveals four concepts upon which the materials are based. The concepts are derived from the manner in which the materials will be used by the educational community. They also reflect the historical development of methods of instruction.

The four concepts may be described as:

1. Textbook or Media
2. Correlated Materials
3. Integrated Materials
4. Systems

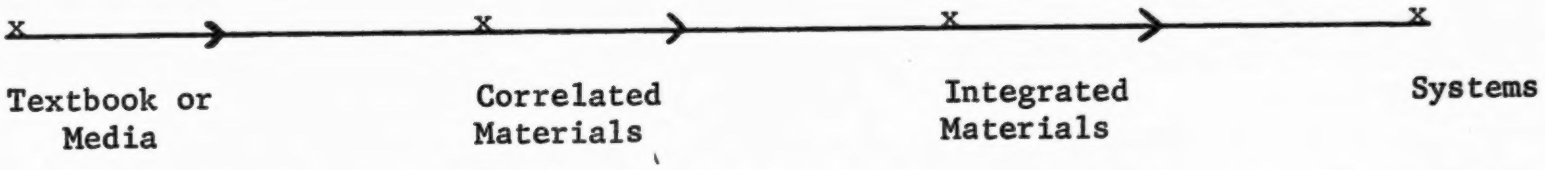
Using the Textbook or Media concept, the publisher or producer provides either textbooks or media that are unrelated. The textbook is central to the instructional process and other media are used to enrich or to entertain. Sometimes the methods of instruction are directed by the content and format of the textbook; frequently they are not. Media other than the printed word are merely adjuncts, e.g. the 16mm. film that enriches or entertains.

Using the Correlated Materials approach, the publisher or producer starts with the textbook as the core of his materials program but, in addition, he creates a host of other items that correlate with the content of the textbook. These items may include any or all of workbooks, films, filmstrips, records, tapes, overhead projectuals, activity guides, and evaluation instruments. The correlation of materials is the responsibility of the instructor, and often the media other than the textbook are ignored. The extent to which the correlated materials are utilized determines the methods of instruction.

Under the Integrated Materials approach, all instructional materials and equipment are purposefully related. Each of the media, including print, is deemed capable of making limited, unique contributions to the presentation of a subject. Consequently, the various media are presented as a "package" to be used in a predetermined sequence. The "package" may include, in addition to printed materials, items such as films, film strips, tapes, records, overhead projectuals, and materials to be manipulated by the student. In addition, the "package" may require the use of specialized equipment such as the tachistoscope or controlled reader. The significant characteristics of this approach as contrasted with the Correlated Materials approach are that Integrated Materials are pre-planned and indivisible. Each unit has an integrity that is not to be interrupted and the methods of instruction are predetermined. The instructor's role is to punctuate student learning with appropriate observations, to initiate and guide student discussion about the experiences they are having, and, based on the built-in evaluation techniques, to initiate remedial procedures for students who are not learning effectively. To gain acceptance in a market that is traditionally committed to "local determinism", producers of integrated materials are marketing packages designed to be used within relatively short periods of time. By varying the sequence in which packages are used, by selecting from the total array of packages, and by punctuating the use of packages with more traditional methods of instruction, the instructor has some freedom in creating his own curriculum.

The Systems approach is a pre-planned, total environment in which the students may function without the guidance of a teacher. The complete integration of experience is accomplished by the machine in response to student feedback. To quote one authority on computer-assisted instruction: "In the computer-based environment, every aspect of the instructional sequence is specified beforehand in minute detail. Every visual display and auditory message that the student may receive -- a reply to every response he may conceivably give -- a decision procedure for utilizing past performance to determine materials to be presented next -- a coding scheme for storing information on the student's data record -- must be planned and prepared in advance. In addition, one has to spell out how the computer-assisted sequence of instruction fits into day-to-day school activity, independent of the computer laboratory."[1] The instructor will engage in supplementary activities that may be valuable and enriching, but the system is essentially self-contained.

The development and production of the four types of instructional materials form a continuum along which movement is occurring:



The movement from left to right would appear to be accelerating. The forces behind the accelerating movement are many, but two are most readily apparent. The first is the scarcity of well qualified instructors. As we move along the continuum, the information and methods of instruction are increasingly built into the materials of instruction. Indeed, proponents and producers of integrated and systems approaches frankly talk about "teacher-proof" materials. On the other hand, critics of the movement talk about the dangers of "regimentation", "depersonalization", and "dehumanization" in instruction.

The second major force behind the movement is the demand for greater individualization of instruction. Until recently, we have offered, through the textbook and the classroom, essentially the same experience to all students. Now, the demand is that experience be individualized and personalized so as to permit the maximum development of each student. The typical cry is, "There are clearly fantastic differences in human beings, and it is high time that we stopped batch-processing them through the educational machine!" The utilization of new media and new technologies presents in the educational process the opportunity to recognize and cater to "individual differences".

Where do we stand in Canada? Most of the instructional materials being produced and used in Canada are in the Textbook or Medium category. A reliable estimate indicates that at least 75% of the instructional materials being used in this country would be so classified. Another 20% of the materials being used for instruction in our schools could be classified as Correlated Materials. Not more than 5% of our instructional materials could be considered Integrated Materials and practically no instruction in this country is using a Systems approach. However, the same forces that are changing instructional materials in other parts of the world are at work in Canada. The impact of the new media and the new technology on Canadian education may be sudden and dramatic.

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[1] Richard C. Atkinson in COMPUTERS AND EDUCATION.

INSTRUCTION FOR TOMORROW'S YOUTH

by
E.C. Frohloff
Bell Telephone Company of Canada

Everyone today is aware of the many technological achievements in the field of education. The full potential of such teaching aids as television, information retrieval systems (both audio and visual), computer assisted instruction, etc. is only beginning to be explored. Development and further sophistication of electronic teaching aids has become a major concern of the communications industry.

The rapid strides which have been made in this field have created problems whereby the electronic or mechanical aid may frequently become an ill-regarded monster unless its uses and limitations are fully understood. If this understanding is absent, it then becomes necessary to adjust the art of teaching to conform with the gadgets available, often with unfortunate or even disastrous results. In some instances, commitments have been made and capital invested in elaborate technical equipment and, only after installation, have the administrators or teachers realized the need, from a pedagogical point of view, for greater depth analysis of its effective uses in the educational processes.

Specific problems which come to mind are:

1. Computer Assisted Instruction: What type of information is to be retrieved? By what physical means will it be retrieved? How is it to be used? By whom is it to be used? Who is to provide the information 'software'? What other uses can be foreseen for the 'hardware'? These and many other questions must be answered before consideration is given to buying a computer, or other such device. Unfortunately equipment is frequently purchased before plans as to its use have been worked out.

2. Educational Television: An eminent educator has stated that, "ETV could well be the most expensive and disastrous single failure in the history of educational technology". The reason lies not in the medium itself, but in its content and use. If techniques for use have not been fully developed, the inclination may be to use the new terminology but apply it to old procedures. Television may be used, purely as a teaching device, still maintaining the sacred relationship of teacher lecturing to pupil, rather than as a means for exploring new techniques using television's more specific advantages (i.e. close-up participation by a large group and instant involvement in current events).

With these and similar problems in mind, the communications industry, Bell in particular, welcomes the research and study being given by educators to determine what methods and techniques can make an effective contribution to the learning process. At present, we have available a variety of communications equipment which can meet many basic educational requirements. We could provide complete video systems, language laboratories etc. and offer them as a communications package, composed of switching and transmission facilities. The system would use the best combinations of microwave, coaxial cable, 2500 Megahertz, telephone cable or combinations thereof. However, rather than develop systems based only on our appreciation of educational requirements, we would prefer to work in close collaboration with the educators; to establish their needs and then design equipment and systems that will effectively meet those needs.

Several experiments combining pedagogy and communications techniques are now underway. They include:

1. V.E.R.B. (Visual Electronic Remote Blackboard)

   This is an electronic device whereby a teacher can write on a transmitting instrument, and his script and voice are simultaneously received at a number of remote locations.

   This was given a trial last year in Riviere du Loup, Quebec, to teach mathematics, language and accounting to approximately 300 adults in nine separate locations.

   Based on the success of this experiment, the Quebec Associate Minister of Education decided to adopt this teaching medium in ten regional School Commissions in the Quebec Region. The system will also be used for teacher enrichment programs.

2. School Sound Systems

   Recognizing a need for a good intercommunication system for pedagogical as well as administrative use, Bell has developed jointly with Quebec Telephone a new design which is at present being assessed by the Quebec Department of Education.

3. Coaxial Cable Distribution Network for ETV

   We are cooperating with several School Boards in the distribution of ETV programs to schools by means of coaxial cable.

Of the many devices available, most realize their optimum efficiency when they can be centralized and shared by a number of groups such as School Boards, University Associations, etc. This requires not only hardware, but communications facilities. We already provide certain items of telecommunications equipment suited to the needs of educators and pupils. However, we recognize the need to develop additional devices, designed and produced for an educational role.

It is the hope of the telephone industry that we can work in close cooperation with the educator in providing the equipment and facilities needed to cope with the instruction of tomorrow's youth. In this way, we can do the job of planning and integration that the whole educational system needs so badly.

A REPORT ON THE ESTABLISHMENT OF THE ALGONQUIN REGIONAL LIBRARY AS A MULTI-MEDIA CENTRE FOR THE DISTRICTS OF MUSKOKA, NIPISSING & PARRY SOUND

by
Bruce H. Gorrill
Encyclopedia Britannica

In any school system a major concern of the educational personnel is the availability of resource material. Too often the frustration of trying to secure books, films, filmstrips and other media from a remote centre discourages teachers to the point where they cease trying. This problem, together with the lack of teacher preparation for the effective use of multi-media, has in many instances kept an effective audio-visual program from becoming a part of many school systems in Canada. Add to these problems the difficulty of overcoming the rugged terrain of Northern Ontario and you then have a background to this paper.

In August, 1960, I went to Parry Sound, Ontario, as the newly appointed Public School Inspector. The inspectorate covered 4,000 square miles from Mactier to the French River and east to Magnetawan. In that area there were 36 school boards, 34 elementary schools, 1 secondary school, 3,000 elementary pupils and 1,000 secondary pupils. There were 2 public libraries, one in the town of Parry Sound and one in the village of Rosseau. With the exception of one local film council which rotated blocks of films and a 16mm projector to several rural schools, the only other service available was from the Ontario Department of Education which loaned films from the Audio-Visual Branch and library books from the Provincial Library Service. Only the five schools in Parry Sound and the one school at nearby Nobel took advantage of the film service from the Ontario Department, as they were the only schools with projectors. The school libraries in Parry Sound were augmented by the Parry Sound Public Library. The rural schools made use of the Provincial Library Service in a limited way.

The whole situation appeared dismal. What was one to do to improve this situation? The Ontario Department of Education would make available on an extended loan basis a number of films to a school that employed 100 elementary teachers if that board purchased an equal number in order that the supply would equal one film print per teacher. No board in the area employed 100 teachers.

In June, 1961, Mr. Ray Smith, the Parry Sound Public Librarian, approached me stating that he had received a letter from the Provincial Library Service advocating a regional public library for the Territorial Districts of Muskoka and Parry Sound. He stated that he felt this would be of interest to me as the schools could participate in the service provided by a regional library. In November of that year a meeting of interested persons -- librarians, trustees and school inspectors -- was held in Parry Sound. The Director of the Provincial Library Service told the people present how to form a regional library. It was necessary for five library boards in each district to petition the Minister of Education for the establishment of the service.

A steering committee was formed consisting of three people, Mr. R.A. Smith, librarian, Mr. W.F. Hammell, school inspector and myself, school inspector. We went out to solicit petitioners, and approval was given to form the regional library in January, 1962. It was then necessary for the Minister of Education to appoint a board of trustees which consisted of five members. This was done. The first meeting of the board was held in March 1962.

In April 1962, Mr. Smith was appointed part-time librarian. Funds were provided by the Ontario Department of Education. Mr. Smith purchased 5,311 books. During the summer a book truck was purchased and an operator hired. In October 1962, the first trip was made to 23 schools and 5 libraries. Schools and libraries could participate in the service by renting blocks of books. These were exchanged three times a year. The books were issued in blocks of 100 books.

The next step was to provide service beyond books. I approached the Ontario Department of Education regarding its offer to loan films to school boards. Since the board of which I was a member was a library board and not a school board special permission had to be sought. The argument I used was that no board in the area would likely be in a position to need 100 teachers. Therefore, why not permit the library board to offer this service to the schools? Permission was granted.

The next problem to be solved was how to find enough money to match the Department's loan with an equal number of films. Fortunately the major producer of educational films, Encyclopedia Britannica, had faced this problem before and had arrived at a solution. The legislation pertaining to schools would not permit schools to enter into time payment agreements. Therefore Encyclopedia Britannica got around this problem by establishing a "rent-to-own" plan whereby school boards had all the benefits of time payments in spite of the restriction that a board could not commit future boards. The school board had the right to terminate the agreement without obligation if they wished. Ownership of the films remained with the company until the last payment had been made. Using this plan we were able to commence film service in September 1964 with 351 films and with a very small cash outlay.

In May of 1964 the board met with library trustees and interested people from the District of Nipissing. As a result of this meeting and several other meetings the District of Nipissing became a part of the regional system. The name was changed to Algonquin Regional Library Cooperative.

With North Bay being a part of the area served by the Algonquin Regional Library a decision was made to use North Bay Public Library as a resource centre. In order to make the reference service available to member libraries and schools Telex was installed in the North Bay Library. Not only were members able to get information from North Bay, it meant the librarian in North Bay was able to secure information from other libraries in Canada where Telex was installed.

The next step was to run in-service programs for teachers and librarians. The Parry Sound Board of Education was persuaded to offer a Saturday course in Audio-Visual Education. The course ran from September 1965 to June 1966, with 100 teachers in attendance. One-day workshops and a week-long summer session were held for librarians.

The following table demonstrates the use being made of the library services:

1962	23 schools	5 libraries		5,311 books
1963	53 schools	12 libraries	5 community groups	10,514 books
1964	83 schools	14 libraries	6 community groups	18,616 books
1965	96 schools	15 libraries	6 community groups	24,190 books
1966	101 schools	15 libraries	5 community groups	28,563 books
1967	Membership fluctuating slightly with schools			Over 36,000 books

Films

1964	351 stock	336 use	September to December
1965	355 stock	1,846 use	
1966	440 stock	2,100 use	
1967	469 stock	2,750 est.	

With the increase in the size of school administrative units more and more school boards are in a position to establish multi-media service. However, there is need for greater financial assistance to school boards in the form of instructional materials grants. Without the assistance of the Ontario Department of Education neither the book service nor the film service would have been available. If teachers are expected to perform their duties and if pupils are to have an adequate learning environment then reference and multi-media materials must be available. The area served by the Algonquin Regional Library is too large to give adequate service in every media. The film library meets the needs of about one-third of the school population. It is hoped that future assistance can be given in order that all pupils will have the greatest opportunity to learn.

COMPUTER BASED COURSES IN TEACHER EDUCATION

by
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University of Calgary

Introduction

This is a brief account of computer based courses in statistics within the Faculty of Education at The University of Calgary.

It is considered that, in view of the impending increase in the use of computers in schools and colleges[1] and the current scarcity of personnel experienced in the use of computers, it is particularly important to familiarize future teachers with such machines. Computers have therefore been made an integral part of all courses taught in the Division of Measurement and Experimtental Design of the Department of Educational Psychology at the University.

Computer Programs for the Naive User

One of the principal difficulties facing the would-be computer user is the necessity of learning well a language such as FORTRAN in order to write his own programs. He may consider this too slow a procedure and attempt to make use of library programs, whereupon he discovers that these are written for use by an experienced programmer.

Faced with this problem, the University of London Computer Unit, as early as 1956, discussed the development of a high-level computer language to be known as a "Statistical Autocode". The project never came to fruition. In the early 1960's the British Psychological Society set up a working party which investigated systems of programs potentially suited to the needs of psychologists in the U.K. One result of this was the recent publication by the Society of A System of Computer Programs for Use in Psychology and Education (Hallworth and Brebner, 1967)[2]. This system, intended for the naive user, provides a basis for the computer-oriented courses in Calgary. Originally written in a variety of English computer languages, the system has now been translated into FORTRAN to be made operational on IBM and similar computers.

In this system it was assumed that a simple and limited set of conventions must be determined and that, whenever possible, call cards should use natural language words. From the viewpoint of the user, the system is divided into several sections. Section I deals with the beginning and end cards, and is always used. Each section deals with one type of statistical operation such as product-moment correlations, multiple correlation and regression, principal components, Varimax rotation, Promax rotation, etc. These sections may or may not be used as required. Where one type of statistical operation may logically follow another, as in the case of a factor analysis proceeding from raw data, several sections of the system may be brought into operation in sequence.

Figure 1 indicates the deck of cards required to obtain principal components from sample data for twelve subjects. In this example, means, standard deviations and a correlation matrix are punched on cards; and four components are both printed on the line printer and punched on cards.

This system of programs is readily available to the user who knows his statistics, is possibly quite ignorant of programming, and has data which he needs to process. As such, it represents a reasonable approach to some of the needs arising from work in education, psychology and certain other disciplines.

Introductory Statistics Courses

The programs have been used successfully in introductory statistics courses. The procedure is first to teach the statistics, such as the computation of means, standard deviations and product moment correlations. The student next works examples using a desk calculator. He then runs the same examples through the computer.

The use of the system can be taught in approximately three hours. Few education students at The University of Calgary have seen a computer before beginning the course. They are given one general lecture on computers and their applications in education. This is followed by a visit to the Data Centre to see the computer and certain unit record equipment, and to learn to use a key-punch. There follows one lecture on the use of the system of programs referred to above. All students then prepare a deck of cards containing test data and instruction cards to obtain the first simple statistics they have learned to compute on a desk calculator, and the deck is run on the computer.

It is considered essential to establish the student's confidence in his ability to make use of a computer. The procedure described appears to give an adequate understanding of the machine, it takes very little time or effort on the part of the student, and it provides immediate reinforcement.

Throughout the course, as each new statistical operation is learned, an example is worked by the computer. Following the initial three hours, comparatively little time is necessary to explain the use of the system of programs.

Students are also required to put through the computer data which they have collected while teaching in school. For each such set of data a complete analysis and interpretation are required. In effect, all statistics are immediately applied in terms of a classroom situation which the student has recently experienced, and in interpreting the results he learns to appreciate their relevance to his future work.

Following the introductory statistics course, all students in classes related to measurement and experimental design are required to be familiar with the system of computer programs, and with certain other programs not presently part of the system. As part of a further statistics course all students are required to learn FORTRAN. This language is taught within the Department of Educational Psychology as recommended in the report referred to above[1] and as part of a statistics course.

Future Development

It is hoped that in the near future it will be practicable to teach FORTRAN, or a comparable computer language, at a much earlier stage. Possibly this will be introduced as a computer assisted learning program taken concurrently with the introductory statistics course. Alternatively, FORTRAN could be learned by means of the student programming language available on the IBM 1130 computer due to be installed in the Department of Educational Psychology in early December.

Provided that programming effort is available, the system of programs for the naive user will be implemented for on-line use in the form of a question and answer system from a remote console to a 360 computer. It will then be possible for a student with no prior experience in computing to sit at the console and proceed to use the programs.

Since it is also the intention to introduce, during the coming session, Iverson's notation in the form of APL or MAT, it may be asked how the use of programs for a naive user articulates with the teaching of computer programming languages.

As high-level computer languages are developed it becomes difficult to make a distinction between languages and suites of programs using their own instructions. The statistical programs described in this paper are not unlike statistical autocodes which have been proposed, and bear certain similarities to the facilities provided by some hardware manufacturers on their remote consoles. They are not broken down into sufficiently small units to enable the user to form new programs, although this facility could be included if necessary. On the other hand, using a simple set of conventions and natural language words, they allow him to analyze his data by means of a number of operations which he combines according to his own requirements.

A system such as this is not, however, intended as a substitute for the learning of a computer language. Its advantages are that it introduces a student to the use of computers quickly (or, in the case of an on-line version of the system, immediately) and successfully, and gives results which encourage him to use the computer again. It enables him to gain a better understanding of statistical operations by using them on a variety of data, and a keener appreciation of the relevance of such operations by applying them to data which he himself has collected. It provides a tool which is readily and easily available for research workers requiring statistical processing of data, and has been used not only in education and psychology but also in medicine, chemistry, physics, engineering, sociology and economics. And, finally, it generates interest in computing which leads students to continue with further statistics courses and learn computer languages.

The function of computers is, presumably, to aid human cognition. The problem is to bring the machine to the human being in such a way that he can use it to perform lower-level cognitive processes while he himself learns higher-level processes. The purpose of the system of programs here described is to serve towards this end.

References

1. Science Advisory Committee, Computers in Higher Education. Washington: The White House, 1967.

2. Hallworth, H.J., and Brebner, Ann, A System of Computer Programs for Use in Psychology and Education. London: British Psychological Society, 1967.

Card numbers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	…	…	Column numbers					…	…	…	70	71	72	73	…	…	…	79	80
1				1																											(Number of sets of data)
2	E	X	A	M	P	L	E		U	S	I	N	G		S	E	C	T	I	O	N	S		1	,	2		A	N	D		3
3				4																											(Number of variables)
4	C	O	R	R	E	L	A	T	I	O	N		M	A	T	R	I	X
5	N	O		M	E	A	N	S
6	C	A	R	D	S																																		(These columns are not read by the program. They are available for private use.)
7	N	O		S	T	A	N	D	A	R	D		D	E	V	I	A	T	I	O	N	S
8	C	A	R	D	S
9	N	O		C	O	R	R	E	L	A	T	I	O	N	S
10	N	O		C	A	R	D	S
11			1	2																											(Number of subjects)
12	(	I	2	,	2	F	2	.	0	,	F	3	.	0	,	F	1	.	0	)											(Data format card)
13	0	1	2	5	3	7	1	0	1	4
14	0	2	3	1	4	4	1	0	8	5
15	0	3	1	7	3	0	0	9	3	2
16	0	4	1	9	3	7	0	9	2	3
17	0	5	1	5	3	0	0	8	8	1																					(Data for twelve subjects, each beginning with a two-digit index number)
18	0	6	1	2	2	6	0	9	3	2
19	0	7	2	0	3	8	0	9	0	3
20	0	8	2	8	4	4	1	0	1	5
21	0	9	2	1	3	2	0	8	7	2
22	1	0	0	7	3	0	0	7	8	1
23	1	1	1	7	3	7	0	8	9	2
24	1	2	2	1	3	8	0	9	3	3
25	P	R	I	N	C	I	P	A	L		C	O	M	P	O	N	E	N	T	S
26	U	S	E		C	O	M	P	U	T	E	D		M	A	T	R	I	X
27	A	L	L		S	P	E	C	I	F	I	E	D		R	O	O	T	S
28	P	R	I	N	T
29	C	A	R	D	S
30				4																											(Number of components)
31	F	I	N	I	S	H

INSTRUCTION FOR TOMORROW (Digest)

by
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Raymond Williams, in many of his writings, has asserted that the traditional central concerns of society -- property, production and trade -- while still important, are now joined by a new emphasis: that society is a form of communication,[1] through which experience is described, shared, modified and preserved. This new emphasis on communications means that equally fundamental to society are the new functions of describing, learning, persuading, and exchanging experiences.

Communication, in the society as a whole or in its sub-aspects, such as education, begins in the struggle to learn and to describe. To begin the process in our minds and our institutions and to pass on the results to others -- variously called "citizens", "students", "learners", "workers", etc. -- we depend on certain communication models by which to make contact. When these models become obsolescent or inadequate, we can modify or discard them. The difficulty is, however, that the rapidity of developments in modern communications and technology generally has prevented us from developing or finding the right institutions ("models") by which the new media, the new technology, may be used. This is true in the context of education and the society as a whole.

Williams also points out that: "if we understand the importance of communication, in all our social activities, we find that in examining the process and the institutions we are also looking at our society -- at some of our characteristic relationships -- in new ways".

What does this have to do with the Canadian educational scene and in particular the role of technology in education? I suggest some major questions we might consider:

- does the new technology stimulate conflict with existing institutional structures;
- if so, what are the implications for technology and media strategy within the educational system;
- how can "academic" freedom, the capacity to explore, develop and seek new approaches be preserved in the face of new conditions, new pressures and new relationships posed by the new technology;
- what are the effects of the new technology on the teacher-administrator-student relationship within our schools/universities;
- to what extent do teachers, administrators and students need to be supported, reinforced, "educated", in their approaches to new technology;
- should the new technology be applied conservatively, modestly, vigorously, radically, systematically, or how?

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[1] Raymond Williams: "Britain in the Sixties", Penguin Books, 1962, p. 10.

Even though we begin to ask ourselves basic questions like these, perhaps we need to dig even deeper. Why, for instance, does the society want to educate its members? Who shall be educated? And to what ends?

Most of us would site the view that the world of the future is one in which learning, information and education will be the keys to development of the society, and the individual. Widely discussed are "automated" futures, and the character of the society in which fewer individuals will perform services on behalf of the total community, which is involved in leisure pursuits widely varied in nature. While many of the fundamental economic questions making such a society possible have not yet been satisfactorily answered, it is clear that we are moving towards a world in which education and skills will be the indices of social advance and reward. Phrases such as "the educative" society have been coined to demonstrate the power of education.

There is another serious social issue involved here, that is tied to the functions of technology in education. Even if we are to adopt the view that the new "educative" society, the new "intellectual" world, is a desirable goal -- even if we assume that no discriminatory barriers, social or cultural, remain in our society, and that status will be assigned on the basis of talent (in the wry term used by Michael Young, a "meritocracy"), the question of what to do about those individuals still remains -- the lower 20% or 25% of the population -- who will be cut off from meaningful participation -- or any kind of useful work at all -- due to lack of basic intelligence, or lack of motivation, or emotional disturbances blocking learning. What can our educational or technological "wonderland" -- vintage year 1970 or 2000 -- do for them?

Educational optimists, like Jerome Bruner, assert that "any subject can be taught effectively in some intellectually honest form to any child at any stage of development". If this is so -- and it is really not yet proven -- it will require a tremendous investment in technology and manpower by society. Faced, even in complacent Canada, with "the revolution of rising resentments", it is questionable whether we will be willing to make the necessary investments.

Concepts and definitions of what constitutes "teaching" are also undergoing radical analysis and revision, as a result of the pressures from technology, the new media, and the needs of the society. There are some who still persist in saying that the "teacher will never be replaced by the machine or the program" when it is observable that on all sides the role of the teacher is changing -- with many learning functions being handled more competently by machines, programs, materials, environment, etc. than humans. No doubt the direct contact between learner and "teacher" will continue -- but the exact nature of the "human relations" involved remains to be worked out. It must be accepted that technology is going to become more significant and powerful than less.

This essentially political question -- that of the role of the teacher -- must be dealt with at a number of levels, but the most important applications are within the professional teachers' organizations. It is a commonplace observation to most people engaged in education that major educational innovations are usually introduced by administrators, not by teachers. It would therefore be useful to examine some of the major influences that are brought to bear on administrators to bring about innovative processes, whether in the area of technology, or elsewhere. It would be particularly useful to know a great deal more about the techniques by which technological innovations are successfully introduced into an educational system.

"The emergence of a new educational technology has brought about the requirement for a new breed of educational technologist to probe, shape, develop and evaluate the new products."[2] One cannot but agree with this statement by Leslie D. McLean. In the same paper, McLean suggests that the best environment for the "care and feeding" of such technologists would provide opportunity and the strong encouragement for interaction with a diversity of disciplines found primarily in a large university community. He emphasizes that the university community model offers independence and freedom, and that these persons must develop a perspective which will enable them to remain independent of suppliers and other pressure groups. To his analysis of the training required, and the functions of research and development, I can only bring agreement, with the added recommendation that prototypes include active working and cooperative relationships with school board teaching aid departments, and college and university instructional media or resource centres, so that a broader basis for investigation, reporting and evaluation may be provided.

It is clear that the learning-teaching function of the educational system now requires the development of skilled practitioners who might be titled "educational technologists". What is not so clear are the tasks of education itself. Are they "to make skilled, even sophisticated, consumers of information", as one commentator puts it? Is it sufficient that the educational system provide the requisite competencies for effective citizenship and the full life? Such views are in essence, expressive of a philosophy of adjustment to society, and therefore only encompass one attitude towards the objectives of education. Education has also implications for societal change, ranging from mild evolutionary modifications to complete revolution. Yet, as John S. Murray points out,[3] "technological devices are purchased to improve a particular aspect of education, not as part of a systematic deliberate attempt to reform education. This means that the new technologies are being used to magnify and intensify the way we now 'do education'; they are not being used to change what we do as education."

As many observers have pointed out, much of modern educational technology is derived from U.S. military research projects, which then have to be adapted from their original functions by manufacturers whose primary and necessary motives are profit-oriented. To some extent, in product or program development, educationists are consulted. But the basically conservative (i.e. cost-conscious) manufacturers, from their point of view necessarily so, due to the heavy expense involved, are usually not prepared to consider that there may be major differences between the goals of education and, for example, a military requirement. If profit motives are to remain paramount, it is questionable whether an "entente cordiale" can be built between education and industry, given these widely divergent objectives.

The issue is further complicated by the development of complex industries having interests in a wide range of products or technological functions. One American company may include in its "repertoire" such activities as broadcasting, film production, text-book publishing, programmed instruction, computer-based learning systems, etc. The real dangers are that education becomes increasingly dependent on fewer and fewer sources of materials, facilities or products.

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[2] Leslie D. McLean, OISE: "Technology and the Control of Education", in a paper presented for discussion at the Conference, University League for Social Reform, October 1967.

[3] John S. Murray: In a paper prepared for the Fall Conference, University League for Social Reform, October 1967.

How do we cope with these increasingly powerful agencies that exist outside the "formal" educational systems? In a real sense, these industries are often so large and all-pervasive as to constitute a new level of educational "government", making decisions and setting goals for learning that are within the capacity of the technique being employed, not those which have been developed consciously and actively by the teacher(s)-learner(s) themselves. What is required is that the relationships that develop between the educational and the business-industry communities be such that goal-setting and decision-making are returned to the hands of the appropriate researchers, practitioners, teachers and administrators in education.

We cannot look seriously at the question of the impact of technology on education without scrutinizing the shape and structure of present ways of handling problems of teaching and learning within our institutions. We must examine the relationships between these institutions and other sectors of the community.

We must also be alert to attempts to encroach on the freedom of education to develop along new lines required by a new world. For example, sudden awareness on the part of provincial or federal governments of the significance of new media for learning (e.g. educational broadcasting) may lead to attempts at legislation to prevent real or imagined misuse for other purposes -- e.g. nationalism, propaganda, etc. In a world of new technological media, with immense and as yet untapped capacities for developing new methods for adult and child education, all avenues to learning must be kept open. Educators must be increasingly sophisticated and perceptive about new approaches that have in the past been foreign to their domain, the classroom. Now, everyone's classroom is the entire world.

Some Random Proposals for Consideration in Solving the Dilemmas of Technology in Education

1. We need to seek sources of greater financial incentives to scholars, institutions, and private corporations, provided by appropriate levels of government and private foundations, to foster local, regional and national projects, stimulating awareness of major problems (and finding viable solutions) related to technology in education.

2. An agency, appropriately funded, should be established at the "federal" level in Canada to concern itself with the sponsorship of major studies of the roles of technology in education.

3. Federal-provincial cooperation could bring together in one region a highly skilled staff capable of working on the applications of educational technology, creating a visible resource centre for all levels of education and acting as a focus for regional or local projects with a technological content.

   Such a task force would have as its assignment the definition of significant problems amenable to technical solution, the evaluation of alternative solutions, the application of systems concepts to the problems, and the stimulation of and cooperation with local educational bodies, universities, etc. to work on specific solutions.

   The nucleus of such an organization may already exist in the Ontario Institute for Studies in Education. Perhaps this structure may be broadened and enlarged by:

a) cooperative relations with other provincial educational centres
b) cooperative projects with local boards and universities
c) effective federal support

4. The federal government, with provincial participation and cooperation, could support the establishment of a "Canadian Institute for Research in Education", providing a national focal point for research on technology in education, involving outstanding institutions in Canada through grants and contracts.

   Such an institute would have a relatively small in-house staff, and would rely heavily on cooperative projects.

5. A major Canada-wide conference of Canadian educationists should be convened to consider the educational consequences and implications of technology. The business sector should also participate actively in such a conference, in an effort towards developing a service attitude to education.

6. Efforts should be made to obtain continuing dialogue and confrontation between education, governmental levels, and the business-industry community related to the role of technology in education.

A SURVEY OF AUTOMATED TEACHING AND LEARNING DEVICES IN CANADIAN SCHOOLS (Digest)

by
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Dominion Bureau of Statistics

In September, 1967, a short check-list was sent to the education departments of the 10 provinces and of the Yukon Territory, as well as to 78 city school boards in population centres of over 40,000. The respondents were asked to add devices that were not on the check-list, and they were also requested to comment freely on any aspect of automated media in connection with school use. At the time of writing (October 16, 1967) replies have been received from all but 5 school boards.

The numbers of children exposed to automated devices, the numbers of teachers making use of them, the numbers of hours of use, and other associated measures of use have not been dealt with in this preliminary inquiry, which presents merely an outline of the picture of the use of automated teaching and learning devices in the public schools of Canada.

List of Automated Devices

The list sent out in the survey contained 24 items; about half the respondents added devices that were not on the list.

Computer -- This most sophisticated automated device is in use in several larger centres for the purposes of: (a) maintaining pupil records; (b) timetabling or scheduling classes; (c) instructing pupils; and (d) cataloguing library books for retrieval. One school has a dial access information device.

Programmed learning -- These devices range from the elementary tachistoscope (which exposes a single word or small phrase at a time) to teaching machines, skimmer, speedoscope (attached *to slide projector*), controlled reader, and key punch simulator. Programmed texts are also widely used in Canada.

Television -- Television receivers, TV cameras, videotape facilities, and entire closed circuit TV systems are reported.

Laboratory -- The concept of a "laboratory" in automated learning is different from that in the physical sciences. The laboratory usually consists of individual cubicles hooked up with earphones, tape recorders, and with master control in the hands of the instructor. Varieties reported include: electronic shorthand, listening stations or centres, language and stenographic laboratories.

Sound or audio devices -- There are public address systems, portable P.A. systems, radios, record players, tape recorders and some report remote control for these.

Still projectors -- Devices for still visual display include: manual and automatic slide projectors, opaque, overhead, filmstrip, and micro-projectors. There are also: microfilm,microfiche, individual filmstrip viewer, microfilm reader, and bioscope. Electrically operated screens and other remote control devices are in evidence.

Moving picture projectors -- Some schools have a rear projection unit, others project from special stands. There are film clips, film loops (single concept), silent films, sound films, and one school has an "instant" movie projector. Here too, the electrically operated screen is reported.

Chalkboards -- Special chalkboards include: auto-flow, electronic remote, and electronic music.

Testing equipment -- Devices are used for hearing and speech testing.

Copying, recording and darkroom facilities -- In many schools using automated devices there are support services that provide materials to be used with the devices. There are: photo-copiers, diazo-printers, thermal copiers, duplicators, Xerox copiers, transparency makers, Thermofax dri-copiers, and photo modifiers. Still cameras for slides and movie camera for 35mm, 8mm, and 16mm films are used. There are videotapings and videorecorders. One school has a complete sound recording studio.

Results of the Survey

Provincial departments of education -- All provincial departments have audio-visual branches, which provide an extensive service in lending films, filmstrips, projectors and other equipment to schools in both rural and urban areas. Advice and leadership are also given.

City school boards -- Of the 78 boards surveyed, 73 responded to the questionnaire. Among the 73 boards responding, the number of different pieces of automated media equipment ranged from 5 to 34, and the median number of different pieces (not to be confused with total number, which was not surveyed) was 15.

Table 1 lists the kinds of equipment used experimentally in order of prevalence among school boards, and Table 2 lists those in regular classroom use, also in order of prevalence.

TABLE 1

EXPERIMENTAL USE OF AUTOMATED MEDIA
NUMBER (AND PERCENT OF 73 RESPONDENTS) OF SCHOOL BOARDS IN CANADIAN CITIES OF OVER 40,000 POPULATION

DEVICE (USED EXPERIMENTALLY)	Number of Boards Using Device	Percent of 73
Programmed Learning Texts	35	47.9
Programmed Learning Machine	18	24.7
Closed Circuit TV System	14	19.2
Tachistoscope	8	11.0
Computer for Timetabling	8	11.0
Computer for Pupil Records	8	11.0
Automatic Slide Projector	7	9.6
Controlled Reader	6	8.2
Listening Stations	6	8.2
TV Receiver	6	8.2
Opaque Projector	4	5.5
Film Clips	4	5.5
Computer for Instruction	3	4.1
Language Labs	3	4.1

TABLE 2

REGULAR SCHOOL USE OF AUTOMATED MEDIA

NUMBER (AND PERCENT OF 73 RESPONDENTS) OF SCHOOL BOARDS IN CANADIAN CITIES OF OVER 40,000 POPULATION

DEVICE (IN REGULAR SCHOOL USE)	Number of Boards Using Device	Percent of 73
Record Player	73	100
Tape Recorder	71	97.3
Manual Slide Projector	71	97.3
Radio	69	94.5
Public Address System	66	90.5
Opaque Projector	63	86.3
Overhead Projector	62	84.9
TV Receiver	61	83.6
Sound Movies	61	83.6
Silent Movies	54	74.0
Film Clips	51	69.9
Language Labs	45	61.6
Tachistoscope	45	61.6
Automatic Slide Projector	39	53.4
Computer for Pupil Records	14	19.2
Computer for Timetabling	12	16.4
Filmstrip Projector	10	13.7
Programmed Learning Texts	10	13.7
8mm Film Loops	9	12.3
Computer for Instruction	8	11.0
Closed Circuit TV System	8	11.0
Videotape Recorder	7	9.6
Programmed Learning Machine	5	6.8

General Conclusions

1. More than half the schools in Canadian centres of population of over 40,000 have available the following automated teaching and learning devices: record player (phonograph), tape recorder, movie and slide projectors of different types, radio, TV, public address system, and language laboratory.

2. Computers are used for pupil records, timetabling, and for instructional purposes in 19 percent, 16 percent, and 11 percent respectively of the school boards surveyed.

3. Experimentally, programmed learning texts, programmed learning machines, and closed circuit TV are used in 48 percent, 25 percent, and 19 percent respectively of the boards surveyed.

MISUNDERSTANDING MEDIA

by
Gordon E. Martin
National Film Board

The glow of the '50's which surrounded educational television has faded. The millions of dollars spent, the millions of words written, the lifetimes of committee work, may have been of personal value to those who were involved. But success seems pretty elusive as Carnegie and Ford ask the public to have another go at it. Even the hardware merchants appear to be disillusioned, Recently, one company took a full-page ad in Saturday Review to show a dust-covered television set with a bold caption which asked, "WILL YOUR INSTRUCTIONAL TV BECOME A DROPOUT?".

Less than a decade later the rapid rise and decline of another classroom panacea, programmed instruction, was an accomplished fact. To be sure, some of the half-warm bodies linger on. They haven't yet been committed to that graveyard of slightly used plastic boxes and workbooks with sliding masks.

Would it be flippant to predict similar fates for such recent innovations as school videotape equipment and computers? Perhaps the tremendous financial stakes which are involved with the latter development will be enough to create and nourish a life-giving myth. Or perhaps their contribution to learning will be inadvertent. It's interesting to speculate about the new roles which teachers and administrators will adopt when computers remove such significant prerogatives as recording the classroom temperature twice daily, collecting milk and insurance money, scoring tests and totalling marks, scheduling classes and football games, preparing the monthly and yearly statistical records, and pouring wisely over multi-million dollar budgets.

The pace of intellectual and technological development presents educators with a rapid succession of opportunities to bring about fundamental social changes. To begin with, these developments have disoriented the public to the point where it is much more open to new approaches in the schools than it has ever been. Unfortunately the same disorientation has swept education, destroying most of the old authoritarian command, and leaving only a modicum of real leadership for substitute. Into this vacuum have moved both the "professional" and the commercial hucksters -- the interests with simple and "to the point" goals. Fortunately a few of them are benevolent and almost sincere.

To capitalize on the potential for change requires leadership which can see beyond the superficial and material levels which usually pass for fact and progress. It requires educators who can operate in the different mystiques of science and art and who can entertain the openness expressed by Whitehead when he wrote:

> "In the study of ideas, it is necessary to remember that insistence on hard-headed clarity issues from sentimental feeling, as it were a mist, cloaking the perplexities of fact. Insistence on clarity at all costs is based on sheer superstition as to the mode in which human intelligence functions. Our reasonings grasp at straws for premises and float on gossamers for deductions."
>
> (Adventures in Ideas)

Given openness and honesty, where can the educator apply his energy to gain insights which will help to create real change?

One significant area of opportunity is in the study of the contemporary environment. To understand what is happening is to begin to relate the potential of public education to social improvement.

Our students are accustomed to studying only the physical and material aspects of the environment. As educators it is imperative that we go well beyond this stage to the world of effects created by modern media. Today's social relationships are created much more by jet planes, satellites and television than by mountains, oceans and the horizon line.

Misunderstanding of media has led to such catastrophies as the demise of educational television. Four years ago the prototype of a cheap videotape recorder was demonstrated to leading educators in New York City. They rejected it because its image was not "sharp enough for students at the back of the classroom to read print on a 21 inch screen".

Broadcast School television has suffered not only from being misunderstood, but from the leadership of educators who refuse to question the basic assumptions of the present educational enterprise. Hence, we find educational television used to display pseudo teachers in fancy classrooms pushing sugar-coated "facts".

Few people seem to realize that the so-called information explosion requires new approaches, not simply a speed-up in rote learning -- a process reminiscent of the teacher who had only fifteen minutes in which to use a half hour radio broadcast. She taped it and played it back at double speed!

The kind of motion picture which we generally use in schools accepts the basic assumptions of earlier media. Some films are even called textfilms! They are generally used to provide a body of insignificant and outdated information to a group of bored students. This is the embodiment of the teaching aids concept -- the suppression of a technically new medium to the creative dimensions of its forerunner -- and its introduction into the classroom to perform obsolete functions.

Perhaps the Maginot Line has to be rebuilt regularly!

The problem is worldwide and from this fact we might conclude that it is a limitation of human perception. R.F. Mackenzie, writing in the Times Educational Supplement (October 6, 1967), about the limitations in "new" approaches to today's youth, says:

> "There are audio-visual aids, closed circuit television, new teaching machines. The B.B.C. and S.T.V. vie with one another in seeking new and compelling ways of putting across the old information. The educationists are prepared to go to much trouble and considerable cost to overcome the increasing resistance to their system of indoctrination. They are not prepared to make a fundamental inquiry into the nature of education itself."

To intelligently understand and exploit media, educators must consider them in a total world context and be prepared to introduce them into the schools as part of a total environment. This goes far beyond the customary notion of a systems approach which is generally based on verbal gymnastics and leaves little room for artistry. It would be interesting to see teacher education courses in which a Fenton actually practised and exemplified his medium, the inductive approach. It would be fascinating to find teachers' college students reading "Explorations in Communication" instead of "Audio-Visual Methods". Perhaps at education conferences we could have Buckminster Fullers, not as the icing, but as the bread and butter -- a function now performed by the Goodlads. It would be exciting to find teachers and students involved together in screen education courses and other environmental studies. How many educational planners have studied the total environment of a Labyrinth, a Metro, a Fairview or Yorkdale shopping centre? How many teachers' courses were held at Expo this past summer?

These suggestions are dangerous for the embedded. It may even be discovered that the most significant educational dropout is instruction itself! But if we believe that the stakes are high enough, we may be willing to take the chance.

TECHNOLOGY AND THE CONTROL OF EDUCATION[1] (Digest)

by
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It seems to this writer that technological developments and the question of control are most crucial in the nursery, primary and secondary schools. These will be referred to as the "schools" in what follows. There may be threats to the independence of universities, and surely modern electronic technology will change the modes and appearance of the learning process, but a great tradition of critical thought and independence will likely permit universities to help direct technological development rather than be controlled by it.

There is neither a reassuring history nor present evidence, however, to convince one that the schools will not continue to sway with the political and social winds. There are, however, some windbreaks and counterblasts to be strengthened and established if the swaying is to be held within limits.

Research v. Development

A distinction is made between research, sometimes called basic research, and development, a process usually associated with practical application of the fruits of research. Sometimes the products of development are called technology, and increasingly the methodology and devices are implied when the word "technology" is used.

Focus here is on development as the process which exerts a most important influence on the day-to-day conduct of education. The dependence of development on research is cheerfully acknowledged, though it is asserted that this dependence has been least marked in the field of education.

Both government and industry play a significant role in determining the amount and direction of attention to the fields of research and development. The government, through setting priorities in the allocation of public funds, can direct to a great extent the activities of persons working in universities and other public agencies. In Canada, for example, very little money is available from the Federal Government to do research which might be applied in education, except in the areas of technical and vocational training. The Province of Ontario, in establishing and supporting The Ontario Institute for Studies in Education, has committed considerable public resources to research, development and graduate training in education, and the resulting activities cannot help but have an impact on the field.

Canadian industry plays a very small role in development because of its subsidiary nature. Very few of the large American companies, with subsidiaries located in Canada, have research and development laboratories in Canada. The implications of this fact for education will be discussed in a later section.

Forces Acting to Shape Development

Much of educational technology in North America today is derived from military research. Modern technology is primarily electronic technology, and the development of sophisticated electronic communications systems for defence purposes has resulted in a considerable fallout for education.

The technology we receive in education, in other words, is often an adaptation of technology developed for an entirely different purpose and shaped for education by manufacturers interested in profit. It is to the credit of the manufacturers that they have sought the cooperation of educators to the extent that they have. It is often far too expensive, however, to change the configuration of the product in any important way, should there be a conflict with some of the goals of education. If this product is to be applied, the goals of education must change -- and they often do.

Another major determiner of the direction and character of development of educational technology is the market place itself. In order for a product to be produced in quantities sufficient to make an impact upon education, the product must be profitable. Prediction of profits is a perilous business at best and a great many preliminary developments or feasibility studies must usually be carried out -- at considerable expense -- before even approximate predictions can be made. There is always the question of whether it can be made in a different way more economically and what effect this might have on the characteristics of the product. Who shall carry out these preliminary developments and feasibility studies? If these are to be left to commercial firms, then a predictable reduction in the expenditure of risk capital will result and the development of devices thought to have marginal utility will surely be slow. In Canada, development in many areas will be non-existent. In short, rather than exploring devices known to be expensive but of potentially great value in meeting educational goals, development will be confined largely to devices for which there is an immediate and substantial market.

Again, it is distressing, frustrating and criminal how little influence the goals of education have had on the development of educational technology, in part because the goals have usually been phrased in such broad and general terms that their implications could neither be understood nor determined. Lip service is paid to such goals and large national meetings set down great compendia of them, but no impact filters down to those who are producing the products which shape the schools. All too often, developers seeking direction as to detailed educational needs find only generalities -- statements which are incapable of shaping behavior in any particular way.

How Development Shapes Education

That tangible products have an important influence on the curriculum in the classroom does not seem to be widely acknowledged, but recent attention paid to the image of the Canadian and American Indian derived from the study of textbooks should drive this point home very forcefully. The same is true of the image of the Negro in American history. The text shapes the course to an important extent. A study of the work-load of teachers in our public schools should convince anyone that teachers have neither authority nor time for independent product innovation, and hence the introduction of a new topic, a new idea, or a new curriculum, must depend upon the existence of textbooks and materials. Entirely aside from the possible impact of the media itself, however, there are direct and observable dependencies built in when complex course materials are introduced into the schools. Course materials are appearing which could never be duplicated by the teacher and which, if used, will in fact determine the curriculum. The teacher will certainly never be replaced by the machine or the product, and the superb, well-trained teacher can dominate any product. The ratio of the number of good, well-trained teachers to the number of pupils is ever-decreasing, however, and there is a very worthwhile and desirable trend toward the individualization of education.

Product development has only recently become a legitimate concern of educational researchers. A serious look at the process of curriculum evaluation has revealed that we have paid insufficient attention to the whole process by which new curriculum ideas are implemented. At last, research is under way across North American into the methodology -- from the statement of community values through the collection and elaboration of specific behavioral goals to the construction and manufacture of physical materials designed to achieve these goals and be consonant with these values.[4]

The necessity for repeated testing of materials and procedures against stated behavioral goals until some empirical evidence is available that these goals can be attained has not, however, been emphasized sufficiently for it to become an accepted part of product development. For this reason we find that publishers and manufacturers are producing documents for use in schools which have not been properly tested and whose educational goals are not clearly stated. Contrast this with the construction and marketing of psychological tests, a much older area of development, and one now much better controlled. There exists a manual for publishers of educational and psychological tests[5] which is endorsed by all of the prestigious educational and psychological organizations. In this manual are set out all of the conditions which must be met before a publisher can put a test on the market and have it endorsed by members of the profession. Social pressure, translated into economic pressure, compels responsible publishers to conform to these guidelines. Work on a similar manual for curriculum products should be started immediately.

The emergence of a new educational technology has brought about the requirement for a new breed of educational technologist to probe, shape, develop and evaluate the new products. New forms of training must be devised to produce this new kind of "researcher". An educational technologist will draw very heavily upon traditional statistics and research design, but these methods are only appropriate in a part of the process. Training personnel and equipping laboratories for pilot technical development will be very costly, but the alternatives should be clear. There is a very real parallel between the field of education and the manufacturers and publishers. If educators put themselves in the role of subsidiary, simply implementing the products of their "parents", i.e. the manufacturers, without undertaking any research and development of their own, then the same sorts of dependencies will emerge here and the control will reside by default with the commercial firms.

This dependency is nowhere more obvious than in the field of computers. Not only educators, but also other customers are encouraged, in fact almost required, to place themselves completely in the hands of the computer manufacturers. If we look upon the computer as it will be used in instruction as just another product produced for us to use in schools, then we must develop educational computer technologists as well. The situation is crucial at the present time in the computer field because a tradition of dependence upon the manufacturers is rapidly building and could easily grow into a stranglehold.

Several important areas are being developed rapidly and need careful attention. One of the most important is software for human-computer interaction. Specialized to the use of the computer in instruction, at least two different needs appear: (1) computer languages for use in preparing instructional sequences, "coursewriter" languages; and (2) computer languages for students to use in interaction. The operating systems and executive routines which will support such macro languages are crucial, of course.

It seems time for a new generation of coursewriter languages to appear, languages which will make it much easier for the coursewriter to employ his arsenal of peripheral devices. These languages must have very fast and very small interval representations in order not to displace and impede the real work of designing and running instructional sequences. The point to be noted here is that very specialized training and experience are required to participate, even in an advisory role, in such development.

Several so-called "student languages" are emerging, the most recent to come to my attention coming from the City of Toronto Board of Education Data Processing Division.

The operating systems, executive routines and the like must also come under the scrutiny of the users, and this again demands that educational institutions have a few of their own highly-trained specialists. If the above needs are real ones, then many of the future educational applications will be on-line real-time applications.

The Educational Technologist

The resurgence of interest in educational research and in the preparation of educational researchers has given us considerable insight into the kind of person who succeeds best in this area. Up until now the persons have almost always received their undergraduate training outside the field of education, usually in mathematics, science or engineering. That such a background is not necessary has been proven beyond doubt.

For the moment one can assume that a budding educational technologist is a bright Arts undergraduate with good quantitative ability and a high motivation for work in the field of education. This sort of person can be trained in two to three years to begin to make significant original contributions to the field. One calendar year's training can produce a capable worker.

The technologist should have the opportunity and strong encouragement for interaction with a diversity of disciplines found primarily in a large university community. Most important are the areas of mathematical statistics, computer science, and active educational research. In short, what is required is a fairly large, high-quality university community. In this sort of environment students can pursue their interests while being involved in ongoing research projects.

It would seem reasonable that the same environment which would best grow educational technologists would also nurture them in their work. The university community model seems important here in several ways, the most important being the independence and freedom such a community offers. It deserves emphasis and re-emphasis that these persons must develop a perspective which will enable them to remain independent of suppliers and other pressure groups who will have a great interest in their work. Especially in the evaluation of new products it is absolutely essential that the technologists develop a very hard-nosed attitude of acceptance only of empirical results.

The Ontario Institute for Studies in Education provides an interesting prototype model for the environment described above. Innovations and concepts developed at OISE must be presented to the schools on their merits and cannot be imposed from above. A spirit of cooperation must be developed for any progress to be made. A conscious and wise decision seems to have been made to leave control of the schools where it is, but to provide an influential and high level of innovation from a university-like research and development institute.

Summary

A distinction has been made between research and development in education in order to highlight the influence of educational technology on the progress and on the control of schools. The emergence of product development in the field of curriculum is seen to have important implications for the whole process of schooling, especially as regards shaping the impact of the curriculum. A new breed of educational researcher, the educational technologist, is emerging to provide an independent guiding force in the development of these new educational products. The technologist should be independent of both government and manufacturers in order to provide objective development and evaluation. This can allow the products to be incorporated in the educational process with some knowledge of the goals intended for the products and the likelihood of teachers and pupils achieving these goals.

The computer is viewed as just one more product, though a very important one, and it seems especially desirable to develop educational computer technologists if we are to avoid an unhealthy dependence upon the manufacturers. The training and direction of the technologists themselves is likely to proceed most fruitfully in a university-like atmosphere in which university level instruction is integrated with active research and development in the field of education. Direct, conscious and explicit efforts must be made to create an environment in which the technologists are not able to impose their findings upon the schools, nor are the technologists subject to any pressures from the government or from the manufacturers. The Ontario Institute for Studies in Education is seen as a useful pilot environment and it is hoped that the vigor and excitement of this new development can be sustained beyond the founding years.

References and Notes

1. A first draft of this paper was presented for discussion at the fall conference of the University League for Social Reform, October 14, 1967, held at Scarborough College of the University of Toronto.

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3. M. Harrington, "The Social-Industrial Complex", Harper's, 235; 55-60, 1410, (1967).

4. Note, for example, the University of Illinois Center for Instructional Research and Curriculum Evaluation (CIRCE), a special division of the Educational Testing Service devoted to evaluation and the Research and Development Center of the University of California at Los Angeles. These efforts received considerable encouragement when the U.S. Government wrote into the various titles of the ESEA directions that evaluation of the programs was required.

5. Standards for Educational and Psychological Tests and Manuals, (American Psychological Association, Washington, D.C. 1966). Prepared by a joint committee of the American Psychological Association, the American Educational Research Association, and the National Council on Measurement in Education, J.W. French and W.B. Michael, Co-chairmen.

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INDUSTRIAL INVOLVEMENT IN INNOVATION IN EDUCATION (Digest)

by
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Introduction

The role of industry in education came into the limelight during the past five years with the rapid expansion of industrial investments in the development of instructional technology, combined with the formation of many partnerships between electronic equipment companies and publishing firms.

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The term "education" will be used in a broad sense, including adult education, vocational training, special instruction, rehabilitation programs, etc. both within and outside the formal educational system.

Industry's Stake as a Consumer of Education

The most significant aspect of the current age is not that we have amenities which the previous generations did not have, but that we live in an era of accelerated change. It is known that the developments in education in general have not been keeping pace with the explosive growth of knowledge and with the profound changes in the occupational patterns of our society. The "knowledge explosion" (now doubling every ten years) defeats any system based on the concept of equipping students with most of the basic factual knowledge needed for the rest of their life. The change in occupational patterns defeats systems rooted in local tradition which tend to prepare sons for the same trade or profession as their fathers.

Since the majority of students leaving the educational systems go to work in industry, industrial capability and competitiveness is directly affected by the performance of the educational system. The phenomenon of sustained technological revolution results in an even greater dependence on modernization of education in industry relative to other occupations. This makes the need for continuing education also greater in industry than elsewhere (with some obvious exceptions).

All modern industries thus have a first-order stake in education. In fact the quality of performance by the educational system is felt much more directly by industry than by educators within the formal system. For example, the need for adaptation to the changing environment must be met by industry on a continuous basis.

An example of a dependence of industry on detailed structure of the educational system is the requirement for portability of education from one seat of learning to another. The wide geographic extent of the operations of many industrial organizations and the general economic requirement for greater mobility of the labour force necessitate industrial concern with the equivalence of teaching institutions at any stage of an individual's progress through the system. The difficulties in ensuring this without fossilizing the system or sacrificing important local requirements are well understood.

Much of the requirement for continuing education of industrial personnel should preferably be met by educational institutions. Nevertheless, industrial firms also run their internal educational and training programs, sometimes on a large scale. Educational leave is also being granted to an increasing extent. It is also foreseen that interleaving in time of several periods of education and employment as a trainee, which is now the subject of several successful experiments in industry-education collaboration (e.g. the University of Waterloo Cooperative Engineering Course) may well become a prevalent future practice. By the time the initial cooperative education and the continuing education programs overlap in the career of individuals, industry, education and the ever-present diverse levels of government will become involved in a state of a complete symbiosis in the educational field.

The electronics industry, being both the cause and the subject of the greatest growth and change, is particularly dependent on innovation in education. Fortunately, it is also capable of positive contributions. It commands the very technology which is crucial to extensive innovation. Also, it understands the total systems approach which has been widely accepted in its own operations. It is therefore both proper and necessary that this industry should cooperate to the fullest possible extent in the interaction between industry and education and that it should mobilize substantial resources for research and development work in this area.

Some Roles for Technology

In considering the possible roles for technology one must start with a recapitulation of the activities of teachers. The diverse activities of teachers may be classified into several groups, as presented below for a conventional situation without technological aids.

1. Exposition*, Drill and Testing.

   The initial exposition, the subsequent drill (or other reinforcing activities) and testing (if any), involving the following sequence:

   - Selection and/or development of material.
   - Distribution or presentation.
   - Collection (observation) of responses and correction or affirmation.
   - Recording, analysis and selection of subsequent activities.

2. Psychological interaction with individuals with respect to factual learning:

   - Stimulation and maintenance of interest and attention to the subject.
   - Stimulation of a wish to learn.
   - Observation of learning processes in individuals.
   - Mapping out individual interests, abilities and deficiencies.
   - Protection from lack of challenge and sustained failures.

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*The term "exposition" is used here to denote the act of presentation and explanation of facts or concepts and a discussion of their meaning.

3. Development of Attitudes.

   - Selection and implementation of activities aimed at the development of desirable physical and mental attitudes.
   - Observation and analysis of progress and selection of further activities.

4. Self-improvement through observation and testing and analysis of own performance.

5. Extracurricular education.

   - Additional activities in connection with extracurricular educational programs voluntarily undertaken by teachers.

The basic capabilities which technology at large can offer to make a teacher's task human instead of superhuman include:

i) Storage (recording) of audio and visual information on a short and long-term basis.

ii) Audio and/or visual presentation from records or from real-time sensors (including "instant" replay).

iii) Audio and/or visual presentation from distant sources connected via communication links.

iv) Special audio-visual effects, e.g. juxtaposition or superposition of signals, magnification, intensification, etc.

v) Facilities for selection (switching) of sources and selection of parts of records within those sources.

vi) The memory and information handling capabilities of computers.

vii) Capability of simple two-way interaction between students and sources under computer control. (e.g. programmed instruction)

viii) Capability for a complex two-way interaction between students and sources under computer control.

ix) Facilities for monitoring, assistance and control by teachers of individual source-student interactions, etc.

The type of the more complex capabilities which are being developed and the use to which they are being put is affected by some trends in educational approach, such as:

i) the objective of equal opportunity for everybody, including deprived children;

ii) accent on learning rather than teaching;

iii) experimental exploration of learning capabilities of humans of all ages;

iv) exploration of relations between learning and presentation;

v) individualization of the rate of progress through a curriculum;

vi) greater need for motivating students;

vii) growing accent on importance of the earliest stages in education;

together with: rapid growth of teaching material; need for more frequent up-dating of curricula; expanding adult education and re-education programs.

In Group 1 activity, machines can carry most of the presentation, collection, correction or affirmation, recording and crude analysis tasks, when suitably fed and controlled by educators. The after-presentation tasks on instructional material will be an exception here in most cases, since these tasks involve teacher's assessment of the adequacy of presentation before proceeding with the associated drills or tests. On the other hand, in drill and testing, machines can even be programmed to select the subsequent action on a short-term basis. The teacher then has the option of controlling the progress on a day-to-day basis, rather than problem-to-problem basis.

In Group 3 and 4 activities technology can provide the stimulation of audio-visual and multi-media presentation; the penetrating insight of TV cameras; the stimulation of real-life recordings or real-time presentation; lectures by masters of presentation; sustaining of interest through instant reaction to students feedback; stimulation by permitting team work or competition with students in distant locations. The technical possibility of simulation games with a computer or self-observation on TV records can bring a new dimension to this field of learning activities.

These are important advantages, but the most important benefit is in teachers' time saved in Group 1 and 2 activities. Relieved from the drudgery of routine and mechanistic work, teachers can again become Teachers. In other words, it may be expected that more extensive use of machines in teaching will lead to teaching becoming more human.

The salutary effect of seeing one's own presentation on a TV recording is well known. Video tape recorders can thus be teachers' best friends in self-improvement work. There should in fact be a fundamental advantage to the self-improvement work in being able to subject oneself to the instructional material (or drill and tests) both alone and with one's class.

Finally, the technological aids, once installed, can with relative ease be provided with further programs for additional educational activities in after-school hours.

Local Systems

A local system links equipment in one room, one building or a small campus. The smallest system is just a few tape units controlled from a teacher's console. Language laboratories are a typical example. Central control is not always present. In fact, there is a considerable trend towards "on demand" systems. These are information retrieval systems in which programs available in a central store are selected from student terminals. Selection by the use of a telephone dial leads to a popular name of "dial access systems". One hundred audio programs can easily be available; some installations go up to the order of a thousand. The limit is set more by the availability of suitable programs and the cost than by any technical problems.

When the control unit interacting with a student incorporates a fully fledged computer, rather than a simple programming unit, computer-assisted instruction (CAI) becomes possible. Most industrial or military simulators used for training purposes represent a special kind of CAI.

It is believed therefore that local systems will proliferate rather than being supplanted by provincial or national systems.

Regional Systems

Regional systems which link a number of schools or other locations of learning in a district via microwave or cable links are beginning to operate in Canada (e.g. Calgary Region Educational Television - CARET). The future of regional systems lies mainly in CAI applications and in pioneering the development of Information Retrieval Television (IRTV). In an IRTV system access to a vast store of information is available through closed-circuit television in reply to demands from users' terminals on a short notice -- seconds or minutes.

Regional CAI (with or without IRTV) can play a predominant role in future industrial training and manpower development programs. An educational system evolved at the New York Institute of Technology has a considerable potential for such applications.

Regional systems can also provide dynamic leadership centres for ETV particularly if provincial and national networks do not develop soon. In the purely academic field, they could become the backbone of new educational complexes, as exemplified in a proposal by Prof. J.S. Marshall of McGill University for Quebec's new Junior Colleges (Les Instituts).

Provincial and National Systems

A highly significant fraction of school population and potential adult students are dependent on broadcast programs as the main modern educational aid. Over 70% of the school population are in the elementary grades. A large fraction of them are still attending small rural and village schools.

In the ultimate development, one-way broadcasting will be superseded. ETV will command a nation-wide network of cable, microwave and satellite links providing two-way communication to every school and, in the end, to every home*. Meanwhile communication channels are very scarce. Much depends on forthcoming government decisions regarding communication satellites. Even more depends on the development of low-cost, high reliability video tape recorders (VTR's) and direct-from-satellite reception. Much cooperation between governments and industry is needed in this area, particularly on the planning side.

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*The return links to the source do not need to have a capability for transmitting pictures. Simple coded messages can be sufficient.

From the educator's point of view, broadcast ETV imposes the constraint of its rigid timetable which is extremely cumbersome. This problem can be largely alleviated by proliferation of tape recorders, particularly if they were reliable enough to operate unattended during the night hours, recording the video material for the next day. Availability of dedicated channels for on-demand reception of selected programs is a better, but more costly solution.

Computer Assisted Instruction

Computer assisted instruction can be introduced at any system level, from local to national, provided that suitable two-way communication channels are available.

Computer assisted instruction is a form of programmed instruction, but it differs from the capability of a simple "teaching machine" as much as a skyscraper differs from a wigwam. There are many forms of CAI and many applications for it. Continuous improvement of programs makes records of computer-student interactions more and more indistinguishable from human interactions. Current work is concentrated on development of instructional material and design of low-cost but high-capability student terminals.

It should be stressed that CAI is not only a powerful technique itself, but is also fully compatible with such other modern concepts as ETV and computerized libraries or data banks. In fact, all these systems can be designed so as to provide mutual enhancement within an overall framework.

Education-Government-Industry Cooperation

1. General Considerations:

The need for close links between education and industry as a "consumer" of the products of educational institutions has already been stressed. The number of past and present R & D projects in the field indicates the breadth of possibilities. At the same time it has to be stressed that there are no reliable and quick methods for evaluating the effectiveness of particular instructional strategies-cum-technical aids combinations. Some ideas have enough obvious merit to obtain support, but years and millions can be spent before the final value and practicability of a concept becomes established.

The first condition for economic utilization of resources is the existence of a good information system. The second condition is comprehensive and realistic planning. For example, it is necessary to select the few areas of R & D activities which can receive major support. The selection should be strongly affected by the influence of a project on our educational independence and by its potential economic value, as well as by the availability of suitable talent and interest. The fact that the number of departments, agencies and boards involved in educational activities does make information exchange and planning extremely difficult.

The two areas of space and education research are, of course, interrelated through satellite communications. The President of the United States recently stated that "the time has come to enlist the computer and the satellite as well as television and radio in the course of education". He proposed a world-wide "network of knowledge" which should help to overcome the problem of education being the greatest bottleneck in economic and social development.

2. Creative Interaction:

No one group has a monopoly on creativeness. In view of the great need, all creative talent relating to innovation in education should be used to the maximum possible extent, whether it is located within the formal educational system, within a level of government or in industry. The available effort should be channelled as far as possible in a way involving educators, administrators and technologists working creatively on the same projects. There is no substitute for the mutual stimulation of such interaction.

It is sometimes said that industrial firms tend to develop educational equipment according to their own ideas of what the educators need and then proceed to market such equipment among the educators, who have no way of finding out in time whether the equipment is useful or not. The answer is that this is a clear proof of lack of communications.

The obvious solution lies with joint R & D experiences which would permit the industry to obtain a better understanding of the educational needs while offering all of its creative experience in display design, man-machine interaction, stimulation of alertness, computer technology, systems approach, etc.

The joint experience must extend into classroom experiments, since technical inventiveness has to be moulded by an understanding of the methodology of application for technical equipment in education.

In the U.S. joint projects are facilitated by the system of grants available from the U.S. Office of Education. In Canada a suitable framework is yet to be developed, possibly in conjunction with the Council of Ministers of Education. It is hoped that this will take place soon.

3. Educational Materials:

Educational equipment is useless without the related program material. The preparation of such material is unfortunately very costly. This is equally true for the traditional educational aids (books, film) as for the new language laboratories, ETV or computer assisted instruction. The suppliers of the more recent technical aids are either blamed for not providing the curriculum material or may be suspected of brainwashing if they do provide it.

In some distant future the problem will disappear through the abundance of program material. Meanwhile, a good policy appears to be the one of ensuring the supply of programs without creating a programming monopoly. RCA is responding to requests from publishers in North American and in Europe for assistance in adapting their textbook series for presentation by means of CAI systems.

The importance of a fast development of good curriculum material cannot be overemphasized. The progress in innovation is more dependent on the development of methods and materials than on technical inventions. The problems of methodology within formal education appear simpler than many problems met in manpower development and rehabilitation programs. Here again close industry-government-education cooperation should provide the most effective route to progress.

Some Economic Aspects of Interaction

It is well known that the cost of a commercial operation is significantly affected by the degree of available information regarding the demand. Unfortunately the educational market in Canada is so fragmented that it is virtually impossible to obtain reliable and up-to-date information about the demand. In many cases even a recourse to costly special surveys is of no help since uncertainties are introduced by unknown elements in the federal and provincial policy, or by a pending legislation. This applies particularly in the field of ETV.

Planning information is particularly needed to stimulate Canadian production and Canadian development in this field. With the overall market only a small fraction of its value in the U.S., any study or R & D effort must rely on Government financed experimental projects to a greater extent than in the U.S., but the practical availability of such projects to the industry is yet to be well established. One often meets tendencies towards restricting publicly supported research to be carried out only within government or university laboratories.

The educators and the government authorities would like to find ways of evaluating the cost-effectiveness of the projects they consider supporting. This is something of a vicious circle since the per unit costs depend on the amount of support received. Furthermore, it is important to select the correct base for evaluation. For example, the direct cost of computer assisted instruction per student-hour takes no account of the full value received from the CAI installation. One should include in the calculation the fact that one hour at a computer-assisted terminal may be equivalent to several hours of conventional group instruction; the fact that the same installation is likely to be used for special instruction to handicapped children, for guidance work, for library information retrieval, for teachers self-education and for all the administrative tasks.

The long-term economic results of being able to supply the education that is needed must also be taken into account.

There is one important factor which is often omitted in economic evaluation, but which is likely to be brought up by industrial participants. This is the high cost of not doing something that must be done.

Conclusion

All industry depends on the quality of the human element in it. The continuing technological revolution demands great changes in education in order to assure that the growing generation will be adapted to the era of change in which it will be living. The adult population also needs continuing education and re-education to an increasing extent.

Leading educators have shown that great improvements in the effectiveness of education can be achieved if one is not afraid of innovation. Still greater improvements can result when the novel approaches enlist the aid of modern technology.

One branch of industry has double involvement in education. This is the industry which not only needs suitably educated personnel but can also develop and supply the technology needed for the necessary improvements in instructional practice. The problems in developing the new educational doctrine and the associated technology are many, necessitating large research and development efforts. The resources are limited. Good planning and the closest possible cooperation between education, government and industry is needed to achieve a sufficient rate of progress to maintain a healthy economy.

The economic feasibility of applying modern technology in education on a mass scale, all across the country, will depend critically on the availability of suitable communications at a low cost. It will also be much affected by the rate of penetration of computers into the daily life of school and industry, including the development of multiple-access information systems.

Some important steps have been taken during the last two years towards building up an organizational framework for research, planning and cooperation in the field of innovation in education. The industrial participants in this innovation need to be included within this framework as full participants, right from the earliest study and planning phase. Such participation is necessary to maximize Canadian production of instructional materials and equipment.

The above arguments were derived from the economic point of view. Innovation in education and educational technology are needed first of all from the human-values point of view. It is indeed fortunate that the two attitudes lead to the same conclusion.

THE NEED FOR PERFORMANCE SPECIFICATIONS FOR INSTRUCTIONAL TECHNOLOGY

by
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Many current articles re technology in education treat the hopes and fears of some of the affected parties. Many contain evidence or rationales to support the author's perceptions. Most of the current articles include exhortations to the readers to be brave, to be diligent, to be cautious. Such admonitions suggest a style of behavior rather than a source of action. Also, the admonitions fail to quell any gut-level queasiness about whether or how the new technology will be exploited, or when, or by whom.

The potential of communications technology for the reform of public education seems clear. The scoffers are becoming less vocal as the evidence mounts. Reservations about automated or cybernated instructional systems are beginning to crystallize around such issues as privacy, role redefinition of practitioners and the need for precise, testable instructional objectives. However, when I look out from the literature to the "real world", any uneasiness returns.

It seems unlikely, to me, that the present piecemeal adoption of new technology by public education will have either significant or long-term payoff. The process of adoption continues while fundamental problems are left unsolved. Some of these problems are likely to intensify. Most will not solve themselves. But outside of a research context, problems do not exist in the abstract. Rather, problems are situations that are seen as uncomfortable by people. People generally try to reduce the discomfort by altering the situation. To many, withdrawal, delay, or denial are just as acceptable in reducing discomfort as direct manipulation of the "external problem environment".

To most everyone involved in education (and that includes almost everyone) new technology presents a problem. Their perceptions of "what is the problem?" reflect their own experiences and concerns. I wish to suggest how some of the parties involved might see problems related to the new educational technology.

To the young child it may be simply that he'd rather watch commercial TV than be schooled or that he'd like more personal attention from the teacher. Adolescents may feel a desire to become individuals and move at their own rate according to their own interests. Many may not find the traditional subject matter divisions, timetables, grades, and teacher-based instruction quite satisfactory.

Taxpayers and parents may want some assurances that they are getting their full money's worth from every tax dollar and that their own children are properly instructed. Some justification for increasing costs of education based on evidence of increased efficiency and effectiveness might alleviate some of their discomfort.

Personnel in the communications industries would like to have precise statements of the performance characteristics of instructional equipment. They would like to know how much of which types will be purchased as well as the purchasing schedule. Such information would help them plan development, production, and distribution of new devices and appropriate software.

Most school administrators want guidelines for the evaluation and purchase of new products. They don't want to get stuck with dysfunctional or quickly obsolete equipment nor do they want to miss an opportunity to be up-to-date and progressive. Some administrators are seeking a rationale for the place of new technology in the school operations. These suspect that there might be a way of tying together language labs, electronic data processing, audiovisual devices, library, counselling, TV, radio, teachers' salaries and working conditions, and computers, to take a giant forward step.

School architects and builders want to know something about the technologies and schooling methods to be housed in their buildings in 5 and 10 and 20 years. It's not enough to say that flexibility is essential -- the nature and extent of the flexibility should be specified.

Teachers, principals and teacher trainers desire freedom from uncertainty and freedom from dysfunctional routines. They would appreciate information with which to defend themselves against accusations of footdragging or faddism.

Assurance that the new technologies will not produce a generation of robots would be welcomed by the humanists. They would like evidence that the young will be properly instructed and that the machines will be exploited fully for human betterment.

Employers are becoming concerned about the retrainability of new recruits. They hope to hire people who will be "with it" today and who are prepared to remain functional as society emerges.

One conclusion from the foregoing might be that "everyone's got problems" with educational technology. If this is true, then it might be inferred that there is a "real" (significant and researchable) problem and that a general solution should be developed. I wish to propose a first (and I believe necessary) step toward such a solution.

Before offering this proposal, I wish to distinguish between education, schooling and instruction. Education is the process by which experience affects subsequent performance. As such, it is ubiquitous and can never be fully defined or controlled. Schooling is a part of education in our society. It is a formal institutionalized activity which provides a particular set of experiences mainly for the young of the society. Instruction is one of the activities that takes place in schools. This activity involves direct purposive attempts to change the students' performance on measurable criteria.

These are rough definitions. They are intended only to illustrate that the problems enumerated earlier focus on combinations or blends of education, schooling and instruction rather than clearly on any one of these. But technology is differently related to each of these. Because instruction is the planned organization of information fields for learners to the end of predetermined behavior changes, technology is most directly and profitably applicable. The applicability of technology to schooling or education is unclear because these are diffuse interactional activities with diverse objectives and difficultly measurable outcomes.

We may assume that instruction and schooling are (or can be) educational. However, we should not equate these with education. Similarly, we should not confuse the application of EDP to timetabling, test scoring, record keeping, or inventory control, with the design of computer based instructional systems. I believe that confusion in these matters is part of the problem. A common language is essential if all the affected parties are to be able to coordinate their behavior and solve their problems. From my standpoint such a language has yet to be developed. Furthermore, I believe it can be developed only as the affected parties work together on a matter of mutual concern. The alternative to such coordinated effort is piecemeal adoption of instructional technology by school boards, futile competition by industry, waste of public tax dollars and frustration for children and teachers.

The establishment of requisite performance specifications for all the components of instructional systems may provide the necessary focus. Simply, we must come to agree on what we want the new technology to do and allow people to do!

At the Metropolitan Toronto School Board's study of Education Facilities, we are trying to establish performance specifications for school buildings. Buildings are, of course, much simpler than instructional systems. Furthermore, the relationship between physical facilities and learning is much less direct than is the case with instructional equipment. However, I believe that our general approach to the problem could have application to the development of instructional technology.

The physical outcome of our study will be a set of 25 to 30 school buildings. It is our intention that these buildings meet the following criteria; suit the original users; be economically feasible; give maximum dollar value; and be easily and cheaply rearranged to accommodate other probable use patterns.

The project is operated to ensure that all affected parties contribute to and participate in the solution. Educational researchers scan the literature and define and describe emerging trends and practices; committees of practitioners help specify the activities of school users to derive their equipment and environmental requirements; architects sharpen the statements of user requirements and translate these requirements into technical language. These technical user requirements are the basis from which precise performance specifications for each component system (structure, partition, etc.) are developed. Manufacturers, contractors, and code authorities are directly involved in the establishment of the component performance specifications. Union representatives and sub-contractors are involved in the ongoing dialogue. Liaison is being maintained with similar projects, especially that of the Montreal Catholic School Commission.

This process brings together the users, designers, and makers of the physical school environment. After a year of operation, our educational researchers appreciate that the requests of the architects for precise, behavior statements are essential to the design of functional buildings. Furthermore our architects understand that schooling is a very complex, fluid human activity, more akin perhaps to architecture than to engineering. The meeting ground has evolved around user requirements and performance specifications. Educators have come to establish what they actually do and the environment required to do it. They do not formulate technical solutions. Architects have come to establish what the components of the building must do and the acceptable limits of such performance. The bidders know what is wanted and are free to use all their resources and ingenuity to produce discrete products as economically as possible. The school children and the taxpayers will be the primary beneficiaries.

Millions have been spent on school buildings and millions more to remodel or replace them. Change in school practice has been hindered by buildings which were not designed for change. Only now are we trying to rationalize the school building and ensure that it meets its intended (although evolving) functions. Surely the lesson has been learned! Surely we will not have to spend millions and waste years of precious time to relearn the lesson in the case of instructional technology!

A systematic national effort is now required to develop performance specifications for instructional technology. These will necessarily be crude at first; there is insufficient research, and new equipment is being developed daily. I do not, however, believe that we can afford to wait. Every day equipment is being produced and purchased. Every day the problems people have with or about instructional technology intensify. The "problems" will not go away or solve themselves. The PROBLEM will not be solved through the fragmented efforts or reactions by the parties involved. In my opinion, a concerted continuous struggle to establish performance specifications is required to exploit the potential of available technology for instruction, schooling and education.

This symposium and the ongoing efforts of the individual participants are necessary and useful. They cannot, however, directly confront the total problem. Perhaps the most useful outcome of this symposium, and our time here, would be a proposal to the Council of Ministers of Education to assume leadership in developing performance specifications for the application of communications technology to schools and instruction. The Council of Ministers is suggested as the logical coordinating body because it is public, national and voluntary. Schooling is a public enterprise. Technology is at least national and more likely international in scope. A valid solution depends on the voluntary cooperative efforts of industry, researchers, practitioners, and the taxpayer. Performance specifications developed under other auspices or other terms of reference seem unlikely to be widely and readily accepted and utilized.

The development of performance specifications is not an end in itself. At least it can help evolve a common language. At best, it could be a firm step toward human betterment through the reform of public education.

COMPUTER APPLICATION IN CANADIAN SCHOOL ADMINISTRATION (Digest)*

by
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There is no question that the computer, which some call the 'heart' of electronic data processing (EDP) has already demonstrated its potential to many segments of our society. This is not yet the case in education though there is now some experimenting with its use in teaching and learning activities as well as in administrative tasks. This paper will be concerned with applications in education administration.

There follows a delineation of the administrative tasks areas which could be aided by EDP and a look at some applications and future plans of school systems elsewhere. Next, a report of the uses urban school systems in Canada currently are making of the new technology and what plans are in the offing. Included is a discussion of the problems facing major school systems who are not now users.

ADMINISTRATIVE TASK-AREAS

There appear to be four broad administrative task-areas which could be served by EDP: general business accounting, teacher accounting, pupil accounting, and research.

The Bureau of Data Processing of the Chicago Board of Education is one of the largest and most sophisticated on this continent. Its hardware in 1963 included three IBM-1401 computers and one IBM-7074 computer. The centre at that time was manned by eighty-three professional staff that included thirty-five systems analysts and computer programmers.[1] Using a twenty-four hour operation, teaching and research applications are scheduled during the daytime and administrative applications at night.

The Chicago operation is unique in that it attempts to develop a "total system approach". What does this mean? Here is an example.

> All development is planned as a part of a total information system. The key is the development of an organization record for every facility, whether it be a school, a central office department, or a warehouse unit. The organization record is built up from factors such as the purpose of the room; the qualifications a teacher must have to teach the subject; the availability of additional support with respect to counselors, libraries, adjustment teachers, and so forth. In the organization record, the system goes so far as to identify the playground facilities that go with the school, the boilers and air conditioning units that serve it, and the visual aid equipment available. As day-to-day transactions in finance, personnel turnover, materials, truck schedules, and student information are performed, data flow across the organization record so that it may be kept up to date.[2]

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*With the assistance of Henry Thiessen, a graduate student in Education Administration at the University of British Columbia.

Thus EDP techniques can be helpful in such diverse tasks as setting up bus service schedules and routes, taking a census of school-age youngsters within existing boundaries to make attendance projections, assigning lockers and auditorium seats, providing inventories of library materials and audio-visual equipment, making financial projections and unit cost analyses, and analysing building utilization.

Teacher Accounting. A second area where EDP may be applied is in teacher and non-professional personnel accounting. The types of information for each teacher which could be stored include: personal data; educational and related data; honours; professional experience in other school systems or organizations; professional references; record of employment with present school system; travel; professional identification and competencies; contributions to teaching profession; memberships; current teaching assignments; administrative and committee assignments; public service record; and record of professional growth.[3]

High speed print-out machines are capable of typing out the answers neatly at the rate of many hundreds of lines per minute. Not only could one secure the names of the teachers but also the current school address and home phone number of each one. If it was needed, an address label bearing the home address also could be secured.

Pupil Accounting. Certainly one of the striking uses of EDP in the area of pupil accounting is in class and teacher scheduling. The most sophisticated of the scheduling programs available this year provide information such as:

(1) courses having fewer than a specified number of requests
(2) students who are unscheduled due to true time conflicts or who have requested unoffered courses
(3) students who are unassigned due to requested classes being filled
(4) courses that require augmented seats and/or had more requests than seats available
(5) a master list of assigned students and their assigned courses by period
(6) number of students unassigned by category
(7) report on available seats in each course (useful in enrolling new students)
(8) report on teacher assignments, and
(9) individual student program cards showing periods, days each class meets, room numbers, and names of teachers.

In addition, such programs can generate for office or teacher use such reports as: class rosters, room schedules, and student summary cards.[4]

Other administrative functions which EDP can serve include: attendance accounting (monthly attendance reports, and a list of pupils who are frequently absent, are two kinds of outputs possible) and pupil registration and enrolment (typical outputs are class records, census roster, a school-by-school roster of pupils who have special health problems, and mailing labels).

Two services which teachers have found to be particularly helpful are scoring and reporting results of standardized objective tests and the preparation of pupil progress reports.

Other possible outputs include the compilation of data on ethnic and racial origin, listing of students by geographic location of home (a grid coordinates roster) to assist in planning transportation facilities and schedules, and a comprehensive record of each pupil's medical and dental history which could be very useful to researchers in those two domains.

Research. A fourth administrative task-area which can be served by EDP is institutional research.

> With the advent of the digital computer, stimulation techniques have been used productively for purposes in addition to instruction, such as analyzing an operational man-machine system and aiding in the development of an advanced system design. The complexity and detail with which the system can be simulated and the variety of techniques used to study, manipulate, and alter the system in order to achieve new objectives or to monitor ongoing functions were not possible before computers came into use. For analytical purposes, simulation has all the traditional advantages of the laboratory over contextual or field research. Whenever a real system is too large for observation, laboratory simulation can be used.
>
> At Purdue University and in the St. Louis junior college district, for example, simulation techniques are being used to forecast building and staff requirements under varying academic conditions. At SDC, under a U.S. Office of Education grant, computer simulation has been utilized to study various types of secondary school organization as they affect the implementation of innovations in school practice -- particularly space utilization, school organization, the handling of information, and the role and duties of teachers. Experimenters have simulated one thousand students going through a nongraded school, with a view to comparing the number of steps required by both "slow" and "fast" students in completing a given unit of work. Important insight into individualized instruction is thus obtained. The goal of the project is to use the simulation model to study changes in school structure and operation, with a documentation of the time utilized in each activity.[5]

Of course, having access to EDP facilities also makes it possible to treat various types of data statistically. For example, one educational computing centre has developed a program that, in analyzing survey data,

> ...identifies the set of independent variables, such as attitudes or demographic conditions, which is most highly related to a dependent variable, and specifies the combination of attributes that best explain the dependent variable.[6]

Another program, entitled 'DATATEXT', is designed for the researcher

> ...who wants his survey data fully explored for all significant relationships, DATATEXT searches the source data for the pattern of relationships, then organizes the findings and presents the output in a fully intelligible English text.[7]

The potential of EDP for improving educational decision-making through making pertinent data readily available is vast.

CURRENT STATE OF EDP USAGE IN CANADA

For this section of the paper, thirty of the largest school systems in Canada were asked the extent of their usage of EDP and their plans for the future.[8] Of the twenty-three systems which responded (a return rate of 77%), 61% (14) were "USERS" and 39% (9) were "NON-USERS".

Equipment. Does your school system make use of a computer?

TABLE ONE

SYSTEMS REPORTING USE OF A COMPUTER

	Size of School System (by student population)		
	Large 49,000 +	Medium 20,000-48,500	Small -19,500
Uses a computer	71% (5)	50% (4)	13% (1)
Does not use a computer	29% (2)	50% (4)	87% (7)
	100% (7)	100% (8)	100% (8)

Table One reports that the larger the system the more likely it will use a computer.

TABLE TWO

SYSTEMS REPORTING USE OF ELECTROMECHANICAL MACHINES*

Size of School System (by student population)

	Large 49,000 +	Medium 20,000-48,500	Small -19,500
Uses a basic complement of E/M Equipment #	86% (6)	50% (4)	13% (1)
Does not use a basic complement	14% (1)	50% (4)	87% (7)
	100% (7)	100% (8)	100% (8)

*Electromechanical machines include keypunch, sorter, verifier, collator, reproducer, tabulator, and accounting machine.

#A "basic complement" for purposes of this study was interpreted as "any four E/M machines".

From this Table it can be seen that, with the exception of one large system, systems which make use of electromechanical machines (E/M) also employ computers.

Certain very specialized pieces of hardware are being used by large systems. For example: four of the large and one of the medium systems use an optical scanner, one large system an interpreter, and another large system an automatic test scoring machine.

Financing and Administering EDP. All large and medium system USERS rented the more costly of their hardware, though four of the large USERS had, in fact, purchased some smaller items. One small USER had a shared-time agreement with another agency.

TABLE THREE

METHODS BY WHICH USERS FINANCE EDP

Size of School System (by student population)

	Large 49,000 +	Medium 20,000-48,500	Small -19,500
Revenue from local taxation only	50% (3)	60% (3)	67% (2)
Some combination of local, provincial, and federal support	50% (3)	40% (2)	33% (1)
	100% (6)	100% (5)	100% (1)

When asked "How does the Department of Education of your province assist school systems using EDP facilities?", ten systems (71%) reported "no assistance -- neither advisory, leasing time on own equipment, nor grants". Only four systems (29%) -- in one province--indicated that advisory services were available from their respective Departments of Education. The dearth of expert advice at the provincial level is all the more serious when one realizes that only three (21%) of the USERS employ EDP consultants. If the analysis of responses are accurate, this would mean nine of the ten provinces in Canada do NOT provide even advisory services and element (79%) of the USER school systems do NOT employ expert consultants in planning or evaluating EDP programs.

TABLE FOUR

NUMBER OF SYSTEMS EMPLOYING EDP IN GENERAL ADMINISTRATION

	Size of School System (by student population)			
Sub Areas	Large(6) 49,000 +	Medium(5) 20,000-48,500	Small(3) -19,500	% of Total (14)
Budget and Finance	83% (5)	40% (2)	67% (2)	64% (9)
Payroll	83% (5)	80% (4)	100% (3)	86% (12)
Inventory and Purchasing	66% (4)	20% (1)	33% (1)	43% (6)
Staff Attendance & Sick Leave	50% (3)	20% (1)	33% (1)	36% (5)

Under 'teacher accounting', some USERS report EDP applications in the preparation of teacher directories, lists of teachers according to certificates held, teacher scheduling, and compilations of teaching loads. Some eight of these school systems (57%) make no use of EDP in the area of teacher accounting. Moreover, according to Table Five, only two school systems report using EDP in recording and maintaining current teacher biographies.

TABLE FIVE

NUMBER OF SYSTEMS EMPLOYING EDP IN TEACHER ACCOUNTING

	Size of School System (by student population)			
Sub Areas	Large(6) 49,000 +	Medium(5) 20,000-48,500	Small(3) -19,500	% of Total (14)
Scheduling Teachers	33% (2)	40% (2)	0% (0)	29% (4)
Directories	66% (4)	0% (0)	0% (0)	29% (4)
Certification Data	50% (3)	20% (1)	0% (0)	29% (4)
Teaching Load	17% (1)	20% (1)	0% (0)	14% (2)
Biographies	17% (1)	20% (1)	0% (0)	14% (2)
No Use as Yet	50% (3)	40% (2)	100% (3)	57% (8)

In the area of "student accounting" EDP is being used most extensively in report card preparation, attendance accounting, registration data, preparation of student rosters, and test scoring and analysis. To a lesser extent it is being used in various timetabling operations and compiling data for cumulative records. Only two school systems make use of EDP in building master timetables. One system even employs EDP in assigning lockers. Table Six summarizes the data.

It should be noted that no school system at present has made use of EDP in such areas as recording and storing post school and medical data.

TABLE SIX

NUMBER OF SYSTEMS EMPLOYING EDP IN STUDENT ACCOUNTING

	Size of School System (by student population)			
Sub Areas	Large (6) 49,000 +	Medium (5) 20,000-48,500	Small (3) -19,500	% of Total (14)
Report Cards	67% (4)	40% (2)	33% (1)	50% (7)
Attendance Accounting	67% (4)	40% (2)	33% (1)	50% (7)
Registration	83% (5)	20% (1)	0% (1)	43% (6)
Student Rosters	67% (4)	40% (2)	0% (1)	43% (6)
Test Scoring and Analysis	67% (4)	40% (2)	0% (1)	43% (6)
Timetabling Operations				
Master timetable	33% (2)	0% (0)	0% (1)	14% (2)
Compilation of subject choices	33% (2)	20% (1)	0% (1)	21% (3)
Sectioning of students	33% (2)	40% (2)	0% (1)	29% (4)
Cumulative Records	66% (4)	0% (0)	0% (1)	29% (4)
Assignment of lockers	17% (1)	0% (0)	0% (1)	7% (1)
No Use as Yet	0% (0)	60% (3)	67% (2)	36% (5)

Only three of the USER school systems (21%) report using EDP in the area of institutional research. All three are large systems (having student populations in excess of 49,000). These systems employ EDP in (1) predictive studies of student achievement, (2) analysis of student retention, and (3) school surveys (including census).

The Non-Users. As mentioned at the beginning of this section, nine systems (39%) made *no* use of EDP. Table Seven indicates that NON-USERS are distributed among the school systems as follows:

Large: one (14%); medium: three (37%); and small: five (63%)

TABLE SEVEN

DISTRIBUTION OF USER AND NON-USER SCHOOL SYSTEMS BY SIZE OF STUDENT POPULATION

	NON-USERS	USERS	
Large (49,000 +)	14% (1)	86% (6)	100% (7)
Medium (20,000-48,500)	37% (3)	63% (5)	100% (8)
Small (-19,500)	63% (5)	37% (3)	100% (8)

Officials of these school systems were asked what was the principal reason why they were not using EDP as yet. The reasons given include: "Too expensive" - 33% (3); "present methods are adequate" - 22% (2); "no experienced personnel" - 22% (2). Two systems did not answer the question.[9]

What role should the Department of Education play? Six (67%) of the NON-USER systems listed "provide necessary financial assistance and adequate financial services". Three of the forementioned plus one other system suggested that the Departments of Education establish an EDP Centre and lease time to school systems. Two systems did not answer the question.

PROSPECTS FOR THE FUTURE

In a recent publication, William T. Knox of the Office of Science and Technology, Executive Office of the President, Washington, D.C. attempts to explain the lag in the application of new information processing technologies in education in this way:

> Perhaps an equally important factor in the educational lag is the traditional humanities orientation of educational administrators, and an unawareness of the power of the new technologies can give both in administration and in instruction.[10]

While such an explanation may also account equally well for the lag which has existed in Canadian education, there is evidence to suggest that at least the largest school systems in Canada are anxious to explore additional EDP applications. Perhaps the prediction that "by 1980 perhaps half the public school districts and all of the colleges and universities in the U.S.A. will be employing remote terminal direct access computers",[11] is not as unreasonable even in Canada as some might have thought if the data on future plans of NON-USERS is typical of smaller systems.

TABLE EIGHT

FUTURE EDP PLANS OF NON-USER CANADIAN SCHOOL SYSTEMS

Task Areas for Which Future EDP Applications Are Now Being Planned	NON-USERS Large (1)	Medium (3)	Small (5)	Total (9)
General business accounting	100% (1)	33% (1)	80% (4)	67% (6)
Teacher Accounting	100% (1)	33% (1)	40% (2)	44% (4)
Student Accounting	100% (1)	33% (1)	20% (1)	33% (3)
Research	100% (1)	0% (0)	20% (1)	22% (2)
No Plans	0% (0)	67% (2)	20% (1)	33% (3)

As Table Eight points out, 33% of the NON-USERS have, as yet, no future plans for adopting EDP. However, general business and accounting is the task area the prospective USER systems identify most frequently as the area in which EDP procedures will be introduced. Student accounting and research do not now have high priority.

What about those systems who now use EDP? Do they plan expansion of present applications or do they feel they are now so far into the future that projecting future needs becomes a low priority item? The data suggests either little ingenuity or an inadequate concept of the power of EDP.

TABLE NINE

ADDITIONAL EDP APPLICATIONS BEING PLANNED BY USER SCHOOL SYSTEMS

Task Areas	Large (6)	Medium (5)	Small (3)	Total
General business accounting	33% (2)	80% (4)	67% (2)	57% (8)
Teacher accounting	17% (1)	60% (3)	67% (2)	43% (6)
Student accounting	0% (0)	60% (3)	67% (2)	35% (5)
No Plans	67% (4)	20% (1)	33% (1)	43% (6)

Table Nine points out that nearly half of the present USERS have no plans for the future and that there are more large school systems which have no plans than is the case with smaller systems. As was the case with NON-USERS, general business accounting is the field wherein the most extensions are being planned. However, ten of the fourteen USER systems plan to extend their computer capacity to include tape-discs. One is considering the installation of a terminal network. It is possible that the addition of such sophisticated equipment may stimulate further explorations of EDP applications in many administrative task areas.

What should be the future role of the Department of Education? Five of the USER systems offer suggestions. Two believed that Departments of Education could assist the adoption rate of EDP by actively encouraging the development of regional data processing centres, and two others suggested the need for specific provincial grants to provide equipment and personnel.

The conclusions reached by Goodlad and his associates in their study of the "State-of-the-Art" in the United States seem to be equally appropriate to the findings of this present study:

> It is fair to say that the general technology has advanced well beyond our application of it. The most striking feature of the state-of-the-art is the disparity between practice and potential, both in the nature and scope of applications and in the breadth of understanding and acceptance of the power of these applications to improve education.[12]

WHAT IS NEEDED?

As with any innovation, the potential innovators need opportunities to become acquainted with the new technique and, if possible, have some first-hand experiences. One group concluded that:

> "It appears...that the use depends more upon an acquaintance and experience with data processing and that certain individuals are available and willing to innovate and assume leadership in their school system for this type of operation."[13]

This Symposium certainly provides opportunities for becoming better acquainted. Hopefully, the proceedings will receive wide distribution permitting many educational administrators in Canada to share in these deliberations. Similar symposia should be organized in each of the provinces to encourage discussion among many more educators and laymen on such topics as the responsibility of provincial governments in promoting wider use of EDP through incentive grants in providing specialized consultant services, and in spearheading the development of regional centres throughout the provinces.

In addition to providing forms at the provincial level there is even now a need to record the experiences educational systems have had to date with the implementation and use of EDP. Much of the "duplication of effort, repetition of mistakes, and waste of scarce human and material resources"[14] could be minimized by men in Canadian education sharing their experiences to date. What is needed is a "clearing house" which would promote the "exchange of technical information and materials on EDP in education". Is this something the Canadian Council for Research in Education might undertake? Ought such an agency be financed by charging a service fee to organizations wishing to receive the "information packets"? Not only would such a facility speed up the wider adoption of EDP, per pupil costs may even decrease as a result of a reduction in questionable procedures.

Finally, school systems in Canada should be identifying personnel now who have an interest in computer science as well as appropriate undergraduate courses in such areas as mathematics and research methodology. Such persons should be given opportunities to pursue specialized graduate study programs at the several centres in this country which have developed programs. Boards of

Education can do much to encourage potential candidates by providing leaves of absence along with adequate salary provisions. Not only will such personnel upon graduation be able to serve in an advisory capacity to their respective boards, they will have the ability to act as the communication link between the EDP specialist (designer, operator) and the EDP users -- teachers, principals, superintendents. Associated with this recommendation is one which pertains to the apparent reluctance on the part of school administrators to engage EDP consultants. To engage competent consultants is as sound and justifiable when planning or expanding EDP services as when building a new college.

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THE FEATURE FILM: CATALYST TO INSIGHT AND UNDERSTANDING (Digest)

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Introduction

While the primary intention of this Symposium is for educators, as well as those in government and business, to consider the new technology and its application to education, this paper is going to suggest practical methods of application of an example of what must be considered old technology. The feature film industry developed from what was essentially nineteenth-century technology, yet it is still not being utilized to any extent in our schools. Industry and government have long recognized the value of the feature film in the study of human relations from a management-development point of view.

Yet, our schools have been slow to develop this great potential. Therefore, from a utilization point of view, the feature film, as a tool in the process of formal education, could be regarded as an example of the new media and the new technology.

There is the comment in one of the other papers that 16mm films are used in our schools either for enrichment or for entertainment purposes. Unfortunately, this seems to be an accurate assessment of the situation; yet it appears to us that the real value and educative potential of the film rests in other uses.

This paper proposes to outline, in general, the value of the feature film, when dealing with selected subject areas, and finally to outline detailed, practical examples of how specific films might be utilized in a classroom. In some experimental courses, feature films are today breathing life into the often sterile and moribund curriculum of our schools. All that is required is a 16mm projector, a viewing surface and a modest film rental budget. Feature films as a basic tool in the process of formal learning is within the reach of virtually all schools in this country, and our hope is that in the future this exciting resource will be exploited to the greatest possible extent.

The Feature Film: Why?

A number of strong factors validate the introduction of feature films into the classroom.

Adolescents possess a strong sense of immediacy. They are attracted to colours, movement, sounds and music. Films communicate by means of such appeals to multiple senses and hence are more directly communicable in comparison with the symbolic abstraction of print. At the same time, feature films are able to breach the barriers of space and time. The worlds of past and future can be made visually present through the research of studio artists and technicians.

One cannot eliminate the entertainment experience involved in viewing a feature film, even though there exists a puritan prejudice towards the value of such experience. The sensory and narrative elements of feature films provide an entertaining experience which, in turn, captures interest. One of the oldest educating devices, the parable, entertained and also illustrated a moral principle. The feature film entertains and, when selected with definite purpose, can illustrate significant areas of human experience.

The Feature Film: Where and How?

It is obvious that uninitiated viewing of feature films does not necessarily recognize the above values. Effective utilization of them must be realized. Films can be used effectively in English Literature, History and Art classes and in an integrated program involving these three subjects.

English Literature

Like literature, the feature film can portray sociological and psychological aspects of life. There has been, however, a disturbing destruction of literature in the hands of those who would understand it and teach it in terms of structural analysis.

For the purposes of literature, feature films can be divided into two kinds: the dream screen and the mirror screen. The aim behind the dream screen, Hollywood's forte, is the perpetuation of modes of identification and escapism. Internal development in such films is premised on the acceptance of a wish to escape reality. While escapism is an essentially human quality, the colour of escapism takes on different tones relative to the time when it is in effect. Compare, for example, the gangster film and The Busby Berkeley musicals of the Thirties with the Spy Drama and sophisticated comedies of the Sixties.

The mirror screen, on the other hand, attempts to reflect actual human experience whether it be subjective or objective in expression. Fellini's Juliet of the Spirits and Watkins' The War Game are both examples of the mirror screen. The former reflects symbolically the internal "forces" and feelings of a personality. The latter anticipates a future horror based on a detailed research of anticipated possibilities and past occurrences.

Both the dream and mirror screens are pertinent to a pragmatic study of literature. Further examples of the use of mirror screen films will be found in the Appendix.

We have not specifically mentioned the value of the feature film as a stimulus to creative work in English composition. Such an application produces exciting results.

There are courses in Screen Arts in existence now that are tending to over-emphasize the grammar of the screen and neglecting its potential for insight. We submit that if this tendency continues or becomes more pronounced, an effective and stimulating teaching tool is liable to become seriously impaired.

History

The feature film, when integrated into the history syllabus, provides a unique opportunity for that history course to become meaningful and relevant to those students who are studying it. While it is true that many imaginative teachers of history are achieving this and without the benefit of the feature film, we submit that the majority of history teaching, at least at the secondary school level, is dull, lifeless and boring.

A stimulating history course will be well-balanced, presenting to the student primary evidence where feasible, and reconstituted evidence where it will be illuminating. As has been already mentioned, motion pictures have a particular appeal that goes beyond that possible in a textbook. Many films have been produced with meticulous detail to historical accuracy, particularly in regard to sets and costuming. Yet, we rarely tap this source.

There are many movies that could provide motivational stimulus as an introduction to the study of a particular unit. Lord of the Flies is an excellent example. This film, adapted from the William Golding novel, provides a chilling and provocative view of the nature of the human being and of the societies which he creates.

Other films can be used to set a problem or a theme. An example here is Viva Zapata which, because it deals with Emiliano Zapata, the Mexican revolutionary, can introduce a study of leadership and revolution.

Another advantage of the feature film to the student of history is that historical problems can be set vividly and realistically in a modern context.

Many objections are raised as to these films being used as part of the study of history. The objection most often heard is that film is art and, as a consequence, has no place in the study of history. We submit that viewing history through the eyes of the artist is not only a valid exercise but could be the most meaningful, particularly if the object of secondary school history is a pragmatic one in the sense that we wish the student to take away an appreciation of himself and his past as a basis for understanding the present and anticipating the future.

Another objection is that a well-known actor portraying a historical figure on the screen will destroy that historical figure as a reality, and as a result, he or she will take on a new identity (e.g. Moses is now Charlton Heston in the minds of millions).

Again, the necessity for careful selection of films is underlined. The teacher must ask himself: does the actor represent the historical character -- not physically, but abstractedly.

Art

It is a well recognized fact that children, as they mature, tend to lose their creative imagination. One of the many possible reasons for this situation is that creative activity in schools has been relegated to a subordinate position. Art becomes the frilly edge on the practical necessity of maths and science. However, in an age when strong creative drives are essential in all phases of life (business, industry, research, education) it seems that the curriculum should devote time to those areas of enquiry which intensify creative imagination. Again, the feature film can be a catalyst to such imagination.

Besides drawing meaningful themes from films one can also use significant scenes from selected features in order to inspire a student towards an understanding of meaningful imagery. By questioning one's emotional reaction to the film sequence, one is ready to begin a process of enquiry through the active expression of personal images which are related to the imagery on the screen. An example of this use of film will be found in the Appendix.

An Integrated Program Using the Feature Film as a Synthetic Link in English, History and Art

Contrary to the increasing role of specialization in work patterns, the recent educational outlook favours integration of subject areas. Integration focuses on the relations of ideas and the breaking of strict delineation between subjects, particularly in the Humanities, is a realistic approach to a meaningful understanding of these "subjects". The rigid study of a subject's internal structure is abstracted from out-of-school experience with its multifarious fields of stimuli. At the same time, rigid specialization at the secondary school level ignores the fact that individuals react to their environment and to ideas with subjective interests and abilities. The integration of "disciplines" allows the individual more scope to understand and, therefore, use areas of study with reference to his personal abilities (i.e. literary, historical, artistic).

With such an approach, a synthetic link is a practical focal point. The feature film provides such a link and, again, an example can best illustrate the film's potential.

Problems

Our system is, of course, rigidly defined in terms of a tightly timetabled, lock-step framework. Often, administrators seem to be more concerned withthis framework than with what is going on inside it. Thus they sometimes balk at the timetable adjustments that feature films demand. But timetables should be flexible to allow for all types of rewarding, educational experiences that do not fall into the prescribed forty-minute time slot, and it is true that more and more of those in authority are attempting to adapt their situations so as to allow inclusion of these experiences. In any case, a feature film can be shown reel by reel in successive periods and often this is useful.

Unfortunately, individual student reaction fits poorly into our present system. Most schools are not physically or spiritually equipped to allow a student to pursue his reaction on an individual basis. Again, this situation is changing, and the transformation will come more quickly as additional pressure is exerted from below.

Another problem relative to the implementation of the feature film is the lack of familiarity of the average teacher with the films and the method of their application. This can be overcome by training at the Colleges of Education in addition to the film distributors supplying guides and manuals for those films that are applicable to the classroom.

The feature film naturally breaks down disciplinary walls and blurs dividing lines. Some teachers are wary of this, claiming that subject integrity must be maintained. However, all of the new media tend to have this effect; thus it is only a matter of time before integrated study becomes a fait accompli.

The distributors themselves present certain difficulties. While the rental fee is usually realistic, they seem to be unduly concerned over 16mm sales hurting their 35mm theatrical business.

Conclusion

The utilization of the feature film promises great potential for the future. As the film producers begin to realize the extent of the educational market, they will begin to specifically market their products toward it. They have on hand now vast resources of valuable film footage that can be utilized successfully in our schools.

Excerpts from motion pictures of doubtful quality could be used to advantage. In the Appendix, we discuss the application of a scene from Green Mansions to the study of Art. Such a sequence, from an otherwise useless movie, could be produced on an 8mm loop and sold to schools. Another example could be the chariot race sequence from Ben-Hur. The list is endless.

The possibility of feature films or feature-film extracts being available on EVR cassettes is exciting and real.

However, this is in the future. What is already being done is the preparation of special school editions of some features. At the moment this is primarily restricted to classics of obvious application (e.g. A Tale of Two Cities) but, nevertheless, it is a beginning. As special school editions are made available complete with comprehensive teachers' guides and supporting, complementary materials, the feature film will become an integral part of every student's formal, educational experience.

Appendix

This portion of the paper is devoted to a somewhat detailed examination of the actual application that certain, representative feature films have in our classrooms. The films that we have chosen are:

- Ivanhoe - History
- The Liquidator - English
- Green Mansions - Art
- The War Game - Integrated study

Our suggestions as to classroom utilization are, of course, not exhaustive but are meant to demonstrate the mode of application only.

Due to the generous cooperation of Film Canada (The War Game) and Metro-Goldwyn-Mayer (Ivanhoe, The Liquidator, Green Mansions), The War Game will be shown in its entirety while selected excerpts from the other three films will be available for screening.

IVANHOE - History

This film is useful primarily in a descriptive role -- that of reconstituting historical evidence. Because of its romanticism and relatively banal plot, its value would likely be best realized with junior classes.

It could be used as part of a unit of study concerned with Medieval England or with the Middle Ages in general.

Topics for Individual Research

1. Describe the techniques and problems concerned with the storming of a Norman Keep.

2. Compare the medieval tournament with the Grey Cup football game.

3. Write a descriptive essay on any of the following:

   - the interior (or exterior) of a medieval castle
   - customs of eating in a medieval castle
   - entertainment of the nobility during this period

4. Research the historical accuracy of any of the following "facts" which appeared in the film:

   - Prince John was "black" and King Richard was "white".
   - The lances used during the tournament were not blunted.
   - The custom of "trial by combat" was still in effect during the 12th Century.

Topics for Discussion

1. What comparisons can be made concerning the attitude of the Saxon to the Norman and the French-Canadian to the English-Canadian?

2. How much has the position of the Jew in society today changed from that depicted in the film?

3. What is your opinion concerning the justice of "trial by combat"?

THE LIQUIDATOR - English (an example of the dream screen)

Questions

1. What does the humour of the film reveal about our attitudes to life? to death?

2. Describe the concept of grandeur as seen in the apartment set.

3. What is the epitome of luxury today?

Projects

- An examination of current trends of plot
- An examination of "selling out" in our age.

GREEN MANSIONS - Art

This provides an example of a film sequence which is strong in visual mood. The sequence can promote the following questions which, in turn, can promote imaginative expression.

1. What is the prevailing mood?
2. How does nature overpower man?
3. Was I drawn into the experience of the screen character?
4. How would I feel in such a setting?
5. Such scenes are foreign to my environment -- do they have any meaning to me?
6. What could the scenes symbolize?
7. What in my own experience is similar?

Compare the sequence to Gaugin's and Rousseau's work.

THE WAR GAME - Integrated Study

This relatively short film (47 minutes) has been acclaimed as one of the most important films ever produced. It imparts to the viewer, with tremendous emotional impact, the realization that nuclear war and its aftermath would be a hell on earth. One can assert, in relative safety, that most everyone is intellectually convinced of the folly of nuclear war -- The War Game adds the dimension of emotional conviction

The film and the theme slice across disciplinary lines and is particularly suited to an integrated approach to its study. The following outline suggests some of the considerations which could be raised as the film is discussed from the point of view of each subject.

History

1. The War Game could be utilized at virtually all grade levels; however, it seems that it would be most appropriate for use with senior classes.

   (a) As the introduction to the study of world history:

      - is this the future for mankind?
      - how have we behaved to date?

   (b) As the final unit of study in a course on Modern History.

   (c) As an integral part of a study of current events.

   (d) As an introduction (or conclusion) to a study of the United Nations.

   (e) As an introduction (or conclusion) to a study of warfare throughout history.

2. Many ideas, concepts and topics for discussion are presented in the film. Some of them are:

   (a) The idea of the "war of the just".

   (b) Does one have a moral right to retaliate in nuclear warfare?

   (c) How much moral responsibility does each citizen in a democracy have to share for the actions of his government?

   (d) Would NATO forces use tactical, nuclear weapons if a clash occurred in Germany?

   (e) Who would be better off in the event of nuclear war -- the survivors or the dead?

   (f) Discuss the proposition that "the first casualty in a thermonuclear war will be democracy".

   (g) Why was this film not shown on television?

   (h) What is meant by the term "the nuclear deterrent"?

   (i) Should there be "priority groups" relative to evacuation proceedings? If so, what effect would these "priority groupings" have on family life, etc.?

3. This film suggests many projects for the history student. Some are:

   (a) A report on the civil defense situation in Canada, including official pamphlets, tape recording with CD officials, etc.

   (b) Preparation of a map of North America illustrating missile sites and strategic targets.

   (c) A report on the possible effects of nuclear attack on Canada:

      - breakdown of civil order
      - resulting mental disease
      - problems of hygiene
      - effect on selected Canadian institutions

   (d) A report of the attitude of the Canadian military toward the utilization of nuclear weaponry.

   (e) A comparison of the effects of the Black Death on a town in the Middle Ages with that of nuclear war today.

English Literature

1. Thematically fits into present courses -- cataclysmic type of literature

- War of the Worlds - H.G. Wells
- The Triffids - John Wydenham
- By the Waters of Babylon - Stephen Vincent Benét
- 1984 - Orwell
- On the Beach - Shute
- The Machine Stops - E.M. Forster

2. The film is science fiction made real. It could be used to intensify the themes of those works listed above.

3. Integration of Literature and Composition:

   (a) Read novel, poem, etc. on theme
   (b) View film
   (c) Write short story or poem based on cataclysmic theme

4. Comparison of film to Samuel Pepy's diary:

   - Black Death
   - Fire of London

English Composition

1. Film used to inspire debates:

   (a) Resolved that nuclear power is basically a boon to mankind.
   (b) Resolved that death is worth the price of freedom.

2. Film used to inspire and provide material for further exploration in controversial essays.

   (a) The Bomb must be Banned
   (b) The Need for Positive Values in Our Times
   (c) The Responsibility of Youth
   (d) Hippies and Fear
   (e) We have Nothing to Fear but Fear Itself
   (f) Escapes in the Nuclear Age

3. Series of panel discussions after viewing film. Various topics on morals.

4. Use in screen education courses:

   - pseudo-documentary technique
   - how achieved?
   - why so much impact
   - compare with Culloden

Art

The film can be used to illustrate the

1. Theme of pessimism in Art. The tragedy of the first World War produced the German Expressionist movement.

Today, we are under the threat of what this film makes real. How does this threat affect the sensitive artist? What forms are the products of artistic minds who are sensitive to the threat of world destruction?

2. The theme of horror in art:

- Siqueiros - "Echo of a Scream"
- Picasso - "Guernica" and sketches for "Guernica"
- Peter Blume - "The Eternal City"
- Orozco - "Modern Migration of Spirit"
    - "Man of Fire"
    - "Catharsis"
- Grosz - "Punishment"
- Goya - "Etchings of War"
- Michaelangelo - "The Last Judgment"

An examination of the theme of horror in art and a viewing of this film could give the student an understanding of the various fears of mankind through the ages.

3. An examination of how artists of different eras fought the destructive elements of their time -- artists can turn their own emotions of hate and fear into positive statements of social consciousness:

- Artists of wartime
- Artists of revolution
- Artists of depression era (1930's)

The film, then, can be a catalyst to direct the students' own feelings of frustration into socially-conscious images.

COMMUNICATIONS, EDUCATION AND SOCIETY

by
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Northern Electric

The world of the common physical sciences has changed drastically during the last half century. Quantum theory, wave mechanics and the Uncertainty Principle have combined to change the essence of these sciences from predicting the inevitable to predicting the probable. The literal acceptance of this change is all the more essential the closer one gets to the basic particle/events under consideration. The measurement of the melting point of a sample of a metal leads to a rather precise answer only because of the immense size of the population of basic/events present. Now, experiments to determine behaviour of the basic particle/events are very costly and complex, whereas experiments involving populations of literally billions upon billions of basic particle/events are almost for free. The costs of experiment then are seen to rise as one approaches the basic events in the common physical sciences.

Interestingly enough, just the opposite situation holds in the social science area as a rule. Here the individual (particle/event) can be isolated and observed with disarming ease, while experiments with populations with statistical significance are very costly and complex. One wonders how long it would take a scientific community, knowledgeable in only sub-atomic behaviour, to predict the simple laws that we first learn in the common physical sciences. One would suspect that progress in the physical sciences would more closely resemble that of the social sciences were the experience with macro-populations in the physical sciences gained only by the expenditure of effort in proportion to the population size. Can one use this analogy to kindle the hope that through the laws of large numbers some simplifications will become apparent in the social sciences when dealing with entire populations? Is this perhaps what Marshall McLuhan is beginning to perceive? Certainly ecologists like Slobodkin et al, seem to be generating what on the surface might be called generalities, but may in fact be like the knowledge of eutectics in the crass physical sciences.

One of the most significant factors in society's environment is the communications fabric in which they find themselves. As more and more of this communications environment becomes based upon electric technology, and in view of the rate at which this is increasingly so, we must learn to predict the effects such systems have upon a given population. Unfortunately there exists no science that can assist in establishing these predictions, no school teaches this subject, and as yet only a few individuals even recognize its importance.

To the extent that education is a significant form of communications environment, we in the communications business proper and you in the education areas have common problems brought about by an undeveloped science of media and societies.

Perhaps the most significant common interest area involves the impact of communications systems on populations as a whole. Or, expressed as a question: given an economically depressed area, what kind of communication services, in the broadest sense, should be established in order to raise the general economic level of that community? To what extent can the introduction of communications services designed for this specific end start an economic spiral going in an increased upwards trend? Certainly these services involve education as we now describe it, but in terms of a total systems approach, the question becomes how can the entire communications fabric in which a community exists be gradually upgraded to act as the carrot to cause the population to literally lift itself out of its present state with optimum overall efficiency.

To be more specific, given a particular school population, what is the effect upon the style of this population of a specific technological innovation? Will it enhance the discovery syndrome, or will it tend to reduce this currently desirable attribute? For example, we suggest that a conventional educational television network system will not tend to encourage such tendencies, but is rather in step with the "seats in a row" style of education. Alternatively, the more discovery oriented manifestation of television is likely to be the instantaneous retrieval system, where each learning unit may select the material it desires when and as often as it desires. With the assistance of the computer to ease the chore of selection and ordering of material, such a system can range over the entire front from teacher aid to computer assisted instruction. As a second example, the video tape recorder can be used to merely re-present already received material, or it can be used actively by the individual learning groups as a means of expression, thereby providing insight into the grammar of this medium.

The slightly different uses of essentially the same technology can result in a significantly different message to the student. In the former case, large expenditures of money could be non-optimally committed if an incorrect decision is taken, whereas in the latter case there is little financial readjustment if an error in strategy is made. It is because of the importance of the former class of situations that we feel more knowledge is essential in this distinctly human ecological area.

In the few short years that the significance of these questions has been recognized we have progressed to the stage where we have a reasonably acceptable rationale for the successes and failures of our past service offerings, but the usefulness in a predictive situation is associated with a dangerously meagre confidence level.

Since interest in these topics extends over such a wide range of professional activities, carried on in so many diverse organizations, we are in the process of establishing a forum for meaningful discourse amongst interested and involved people. Under the tentative title of a "Media Arts and Technology Association", we hope to initiate publication of a journal dealing with the relationships between the general communications environment of a society and the style of that society. Recognizing the fact that technology, or methodological know-how, frequently precedes science per se, a particular emphasis will be placed on devising a technology of communications environment design, using the term communications in its broad sense.

With proposals of chequeless societies, National Scientific Information Services, Artificial Intelligence Systems, Computer Assisted Instruction Systems, etc., being bandied about, we feel that to delay the bringing together of what competence exists today could nullify the value of whatever contribution could be made by this competence. The large scale problems are with us today, they are real, and decisions are being made today that might better have the benefit of at least a little knowledge while these decisions are at the formative or planning level rather than waiting until these decisions have been frozen into irreversible plans of action while a full scale science of communications and society is being developed. We would solicit the support and contributions of the educational research community for this effort.

INDIVIDUAL DIFFERENCES AND THE NEW TECHNOLOGY

Chairman - Dr. L.D. McLean
OISE

Members - Mr. D. McLaren
Air Canada
Dr. W.D. Barry
Université d'Ottawa
Dr. H.J. Wallin
U. of British Columbia
Dr. J. Fritz
University of Calgary

Dr. McLean: In our meeting over breakfast this morning, we decided on somewhat of a format. We decided that we would pre-empt this opportunity for a little scuffle amongst ourselves. You'll have to pick on the panelists here if you want to challenge them on their views -- either that or assert yourself sufficiently forcefully to get in. Now, I'm sure that many of you have had experience in faculty meetings and in meetings of staff, and can surely manage this if you wish. But we thought that we should give these gentlemen a chance to have at each other in public; in the discussion groups anyone who wishes can pursue this further.

My own participation will be made in the introduction in which I will try to convince you that we do have a topic, namely, Individual Differences in the New Technology. I am lucky to have copies of Dr. Wilson's paper from last night because I can refer to a couple of the graphs in that paper. One of them you should consult and contemplate. It shows you what kind of individual differences there are. Anyone who takes the time to actually look into this and not just rattle off the term "individual differences", finds that the differences are enormous. I recall Patrick Suppes' talk before the American Educational Research Association, three years ago this February, in which he made this point very forcefully. He says we all give lip service to individual differences, but we don't really realize how great they are. In other words, the fastest and slowest students in his program, after less than one school year's work, were so far apart that they could be said to be in different courses, even though they were studying the same thing.

Now, the next point can be gleaned from a couple of pages over. You might say, "Well, that's right, you know, the fastest and slowest kids are always a long way apart". But it's worse than that. In fact, the rate of increase of the gap will also grow. The fastest student picks up speed as he or she goes along, whereas, it seems, as Dr. Wilson said last night, the slower students reach a plateau in their rate of growth. The whole point is, we're dealing not only with a velocity problem here, but also with an acceleration problem. Anyone who professes to glance at individual differences and say that some attention should be paid to them, should agree right away that we have a terrific problem on our hands.

Let me bore any of you who were in Regina and heard my talk there with what has become my favourite quotation. It comes to me very forcefully at a time like this, because when teachers do allow for individual differences, there is going to a great deal of chaos. The students are going to go their various ways, and it's going to be very difficult to keep track of them. In a book entitled Augmenting Human Intellect, I came across this phrase, "the computer gives us the freedom and power of disorderly processes." I hope this is so and I'll now turn this over to the panel, hoping that they can clear up all these problems for us. Don McLaren:

Mr. McLaren: What Les just said is, I think, an excellent note for us to take as a beginning. There's a phrase that I recall from an address by John Kenneth Galbraith in 1965 in Australia. He said that it is the vanity of educators that they shape the educational system to their chosen image. I might point out here also that it is the vanity of organizational people in business and industry, and for that matter in government at all levels, that they do precisely the same kinds of things. One of the things that I think we're becoming slowly aware of, is that a great deal of this is done with very little basic attention to what we're trying to do. The organizations "grow" like Topsy, the administrative systems "grow" like Topsy so that the fundamental problem, so far as I'm concerned, in taking the theme of this panel -- Individual Differences and Educational Technology -- is really one of asking ourselves: "What the heck are we trying to do?". Dr. McLean was talking earlier this morning about the standards, but the selection of standards, to me at least, subsumes a whole process of goal-setting, of questioning and of designing based on the choosing -- you'll notice all along I'm using gerundive forms presumably continuing an ongoing process.

What are we trying to do? Well, let me be provocative here, perhaps, and say, so far as I'm concerned, in a matter of facilitating the individual differences, facilitating the handling of individual differences, really, the goal that I would opt for would be to concern ourselves with systems design; designing environment within which the individual's experience of achieving is being continuously optimized. I submit that we can do this; I submit that we can do it, and that we can do almost anything that we want, and therefore a discussion of the technology, the hardware and even a great deal of the sophisticated software is irrelevant, until we have decided what we want to do. We can design systems in which the child is being continuously frustrated, in which he develops a very appreciable sense of guilt and shame -- you can do these things. It's often said that the computer is impassive and it won't hit the child on the head, but you could design a system so that it would do precisely that, if you wanted to do it that way. So far as I'm concerned, the question is: What do you want to do? I want to design a systems relationship in which the individual's experience of achievement is being continuously optimized. I'm sorry, I said "achievement". I should have said "achieving" -- as a continuous ongoing process.

Let me just add one thing here. When I talk about education, for this, read: "Learning and Achieving" and also read "The Individual's Ongoing Learning Experience Throughout His Whole Cotton-Pickin' Life" and that involves us and our responsibility just as much as the educational establishment per se.

Dr. McLean: Thanks, Don. Do we all agree that when we talk about technology, that we are talking about the broad range of resources available, certainly not just the hardware? Do you want to say anything about that? Perhaps John Fritz will take up that point.

Dr. Fritz: Yes. Let me make a few comments with respect to the typical existing situations where schools in some cases are trying to come to grips with this very difficult problem of individual differences, and relating instructional resources or multi-media to them. To be sure, in most of these cases where some attempt is made to expose learners to a variety of media -- that is, picture and word basically -- in order to overcome some of the difficulties of learning that some youngsters experience, we have a number of interesting things happening. First, we have to remember that the schools have largely available to them the resources, that is, the materials, the filmstrips, the tapes, the records, the motion pictures and so on. What they do not have available is the kind of sophisticated systems needed for storing and distributing the materials. As a result, with the lack of necessary hardware, in this case interestingly enough the schools are faced with having to make up this deficiency with human resources of various types; and these types range from the technician level to the more specialized and professional types of consultants in the system, which again are lacking or in short supply. So that, given this disparity -- by which I mean that we need to move very quickly ahead in dealing with problems of individual differences among learners; but in moving ahead, as some of them do, they get into great difficulties of other kinds. I just wish to mention a few of these.

Number one, as Les McLean has already mentioned, in referring to Dr. Wilson's paper, is that differences among learners actually increase, at any point in time, in addition, to be sure, to the rate of increasing differences. But differences of themselves are bad enough as these increase among learners. This has become rather evident in a number of projects, but especially in a few of them that we've conducted over some period of time.

What teachers generally find, who take a typical group and try to differentiate instruction in the light of learner characteristics, is that they get out of phase -- that is, the learners get out of phase. Now, this is a bit of a jolt because most projects do not involve a basic reconstitution of the classroom design -- a teacher is still involved with thirty to thirty-five youngsters, and the hope is that after differentiating the program a little bit for a short time, they will bring them back into the same constellation, as a group. This they find very difficult, of course, because of the phenomena of increasing differences in learners, if you do cater to these after some fashion.

As you try seriously to accomodate learners' differences in the programs, this in effect spells the end for any traditional kind of classroom activity. They get out of phase and then you don't quite know what to do. Generally what happens is a reversion back to the "normal" situation. This is, I think, the one reason why many so-called "team teaching projects" seldom get off the ground, or they stop at the mass, large-group situation and never get to individual study; because once you really invoke small seminar situations and individual study, you can't bring them back en masse too readily. You can't justify the single kind of message input for a hundred or a hundred and fifty learners as a steady diet.

This is one sort of situation. The other kind of thing that we have noticed relates to filmstrips and motion pictures, for example, being made available to learners at their request. Some projects, Etobicoke is one of them and there are others on this continent, have tried to introduce more frequently and more regularly, at the behest of learners, the variety of learning resources, such as filmstrips and motion pictures (I refer to these two media, because by and large these are available in plentiful supply and therefore schools can embark on projects like this). Learners can go to a resource centre or library and select a film or a filmstrip from the shelf and expose themselves to it. We have here a kind of anomaly occurring with respect to the general way in which most teachers have been teaching. The first criticism on the part of some teachers after this has been going on for some time is that learners tend to expose themselves without a clear notion of what they ought to be doing -- that is, without a clear learning purpose. And the allegation is that they expose themselves for the sheer experience and joy of exposure and of viewing the material. The result they claim is a redundancy. They say that when they want to use this film or filmstrip in class a number of youngsters have already seen it. This presumably isn't good. The other thing that tends to happen is that not only is it redundant, but the learners have great difficulty in accommodating to teacher purposes, when they come back to the classroom which, incidentally, is still under the control of the teacher in terms of making such decisions as need to be made. Once you start to invoke the individual learner in some significant way in the instructional program of the schools, the relationships between learner and teacher, in terms of decision-making agencies, clearly change and change rather dramatically.

Now, I make this point because there is a good deal of evidence within our school systems that teachers and in many cases, administrators are acutely aware, not only of individual differences, but of the multiplicity of resources that are becoming available. But in an attempt at introducing these effectively into ongoing programs, there are all sorts of gaps, not only conceptual, in terms of purpose, but procedural, operational, and in a lack of hardware adequate to back up the resources and collate them in some effective way.

Dr. McLean: Thanks, John. Dr. Barry:

Dr. Barry: I've come here basically to learn. You gentlemen seem to be very sophisticated with the topic. For the moment I will not deal with the applied problems as they've been expressed by my colleagues so far. I would like to adopt an optimistic point of view. Perhaps my perspective is a little too ideal and a little too futuristic but I can see the employment of computer-assisted instruction as effecting two very dichotomous things: one, in a sense, is the regression or the repression of individual differences in that the communality, the segments of communality in the species, would be more recognized and a lot of communication and semantic barriers would break down. On the other hand, as the process would advance -- that is, in time -- either for a system or for an individual, following the assimilation of the common element, we would allow him to play the scherzo. In other words, it would provide for an enhancement of individual differences and in a sense also produce individual differences. Perhaps some of you are familiar with such work as Guilford is doing on his Model of the Intellect, and the factors that he has obtained so far, seem to be in direct proportion to the number of tasks that he utilizes in problem-solving. In other words, if he used a test of picking up buttons speed or knocking in construction nails, for example -- being facetious -- if he did this sort of thing long enough he'd probably come up with a factor synthetically related to the task -- to any arbitrary task. And I think this is what we'll find in computer-assisted instruction; that as individuality develops with the use of a very dense information input, we'll find new individual differences related to this learning that we never anticipated.

I think there will be monstrous-sized problems until we reach the stage where the accessibility to and the spectrum of such information would provide the artist with the opportunity to play the scherzo regardless of the common element in the concerto, if you follow my idea. I think it's a French proverb that says "culture is what we have left after we've forgotten all the facts". I can see this as occurring also with the amazing amount of data available to any one child at the optimum point. By this I mean, instead of quantifying how much the child has learned, we might reach the stage (and I think a very sophisticated and mature stage) where we're only interested in how much the child has lived.

Now, experiments, especially at the University of California at Los Angeles, have been conducted on the effect on the human brain of increasing the frequency and the loading of stimulus input. And we know that children who are subjected to very rich learning climates and expected to do a lot of problem-solving do develop the brain actually physically more than those in a deprived climate. Here again, we do not destroy individual differences -- certainly not -- but we can expect, with computer-assisted technology or teaching, that the basality of individual differences, though remaining constant, will shift. This also, I think, is a point to consider; that while people will always differ, despite our democratic biases, the basality or level of operation may enhance the society a great deal. These are just a few points that I have considered.

Dr. Wallin: Let me comment at the outset on an observation that one of the panelists drew to our attention earlier: with the know-how we are acquiring in hardware and technology the most wild-eyed dream of the educator is now realizable, given time and money. The many excuses we now make to account for our persistent lack of success in accomplishing many of the school's tasks will have to be reformulated. For example, such phrases as "we know of now way to..." in many instances can now be replaced with, "we know how to but lack the funds to...". If such is the case, the critical question becomes: what is it that schools ought to be doing? While this question is both old and perennial, it must take on a new significance in this technological age where every wish is a possibility. Several other questions immediately follow upon the first: what groups in society ought to be involved in determining what schools should be about? By whom and by what means will divergent goals be accommodated? Can all segments of a society be accommodated (given our increased technological sophistication in providing for individual differences)?

Questions of "what, where, when, and why" now appear to be even more crucial than "how". Educators everywhere need to be encouraged to grapple with such questions and to understand their relationship to the broader area of social policy formulation. If little thought is given to educational objectives an increase in technological efficiency will likely have no greater impact than make easier what is now being done. Perhaps the Canadian Council for Research in Education might convene a symposium which would prod leaders of school systems to examine alternatives to present programs and structures -- alternatives which are made possible through the greater capability of electronic data processing, for example.

This introduction leads me into commenting briefly on the outcome of a study I undertook this fall. I questioned our thirty largest school systems in Canada about their use of electronic data processing techniques in assisting in the administration of those systems. With few exceptions those school systems which were making some use of EDP were simply attempting to do better what they were already doing. While this is commendable, it overlooks the demonstrated potential of EDP to assist in long-range planning and in evaluating the effects of various decisions in a simulated environment. Only one system reported plans to use the computer to assist in long-range planning.

Several school systems, according to the study I made, are beginning to apply EDP in ways which make it possible to better accommodate the wide-range of differences both in students and in teachers. I refer to the computer programs which are available to administrators for timetable construction. Large secondary schools making use of such computer programs are now able to schedule a vast array of individual student programs and cater to the special desires of their faculties. One writer has pointed out that Miss Jones, for example, might feel that the early morning sun coming through her fourth floor window is the source of her daily inspiration; Mr. Roberts wants to remain unassigned to a seventh-period teaching duty so that he might work with another staff member on a joint project; and so on. Such delicate nuances in timetabling are entirely possible.

It may interest you to know several systems are now enlarging the amount of information which will be stored on computer tapes. To have the right kinds of data readily accessible should assist teachers in diagnosing pupil learning needs and in periodic stock-taking of human resources by the school systems themselves.

There is some talk that EDP can decrease the amount of clerical work which a teacher ordinarily performs. It is true that the computer can assemble class lists, score and evaluate tests, assemble pertinent data for pupil report cards, print the cards, and summarize the work of each youngster over a specific period of time for the use of counsellors in parent-teacher conferences. But, it is also true that humans must collect and feed in the data before such elegant outputs are possible. Who is best able to do this? The person on the job -- the teacher. Once collected and stored, the data must be continually up-dated. Who is handiest and now sophisticated in data collection? The teacher.

The evidence seems to suggest that EDP does not reduce the amount of clerical work required of the instructional staff but greatly increases it. If school systems wish to maximize the returns to education from an investment in electronic processing technology, they must also increase their investment in a greatly expanded non-professional clerical staff whose task will be the collection and continuous up-dating of information vital to every modern organization. If not, there will be a considerable reduction in the returns the system will get from the already large investment in professional staff.

Let me conclude with a caution. As a student of complex organizations I am conscious of what some have called the administrator's "power syndrome". School administrators, like other kinds of senior bureaucrats, seem to have a great desire for power -- ultimate and all-encompassing -- and the new technology can easily serve as an excuse for obtaining more, not less, conformity within the school system. Conformity is both elegant and neat. So, instead of being an instrument which has the potential both to provide greater flexibility and allow for greater divergence in practice, EDP could be used to acquire greater conformity. School administrators should resist such temptation; teachers should assume greater responsibility in formulating policies for the proper use of the new technology.

Dr. McLean: I don't know what's operating -- perhaps the early hour -- to induce such reticence from these gentlemen, but I do think that they have made some statements on which they need to be prodded. I think the one that intrigues me the most has occurred in practically every talk. It refers to what I consider to be a trend all over the world, but certainly in North America. Young people are demanding, and in many cases receiving, a greater voice in determining how they shall be taught and how they shall live. This is now very apparent in the universities; it is becoming more obvious in the schools. A number of children, for example, are asserting their will simply by dropping out, and the number is getting large. The number of "respectable" youngsters who are doing this is getting so large that some people are saying, "better see what's happening to these kids". And whatever might be happening, there is this demand for a greater say.

Dr. Pullen: What statistics have you that there are more students dropping out now than there were twenty years ago?

Dr. McLean: I don't think I said more are dropping out.

Dr. Pullen: You said "more and more of them are dropping out".

Dr. McLean: Well, I think......

Dr. Pullen: Well, I don't ask what you think; I want to ask, do you know?

Dr. McLean: Okay. I only know what I read in the papers that there is concern about the number of kids.

Dr. Pullen: No, no. Now you said more kids are dropping out. Now are there?

Dr. McLean: Okay. Dr. Pullen makes a valid point here, that I haven't the statistics to back up what I say, and so I shall.........

Voice: Shall I give you some support there, Les? And Harry too. So many kids are staying in school that those who drop out are more noticeable and I think, Harry, you would tend to agree with that.

Mr. McLaren: Okay. Let's add this: let's use the phrase "dropping out" as the hippies use it. Now, add that to the problem of statistical dropouts in terms of physically leaving the school, add the psychological or emotional dropping out, and I think Les' point is completely valid.

Dr. McLean: Let us move on, because I wanted to deal with the ones that stayed in. However many there might be who choose to stay in, the point is that if indeed the student does take any responsibility for his own learning pattern, then we are into a considerable difficulty administratively. That is, we have explored this, and attempted to put it in perspective, since a number of members of my department want to construct a curriculum in which the student can make a good many of the choices. Now here is where I want to comment on what Jamie says. He's perfectly right that the computers are not going to relieve the teachers of the clerical work -- they're going to pile on more. As a matter of fact, the poor teacher is going to get worse and worse off if everything has to go through the teacher and the teacher is on top of every detail every minute. You just can't run a complex system through the eye of a needle like this. The way the teacher is going to be relieved of some of the duties is for some of the clerical work, for example, the records, to be kept automatically without the teacher having to look at them. What has happened? Some administrators have said, "We're going to collect this information by computer", but they run it through the teacher before they run it through the computers. What individualized instruction has as a goal is for the student interaction in the course of his learning process to be recorded and summarized automatically for teachers and administrators so that they can act on the information. The information is collected as a matter of course and summarized and compacted and presented at a time when the teacher can best make use of it.

Now, I would like to see the student have more say in what he learns, because I've come to believe that however inept they might be in the beginning, the seeking is worth something. Yesterday we had a talk from Professor Hicks of the University of Illinois who was dwelling on this point with regard to a course he had given there. And he said that almost to a man the students are coming up and saying "the problem is you've been lecturing to us and we would like to start with what we think are the important things". The students add, "we may be wrong; you'll have to direct us to some sources and point out where we're naive and ill-informed, but the resulting process is going to be much more beneficial to us". These things are coming. Gentlemen, I wonder if you're afraid of this or if you welcome it?

Voice: Before the panel answers, could we deal with grade levels here? What are you talking about -- are you talking about high school, university, when you talk about individual choices?

Dr. McLean: I'm personally talking about an ever-increasing participation of the student as he proceeds through his schooling. In other words, two-year-olds make very few decisions about their schooling now. Who knows whether they should make more? But I think Grade 12 and 13 students make very many too few decisions about their schooling; and my contention is that the schooling process from beginning to old age should evolve with an increasing and gradually dominant role of the learner in deciding what he's going to study.

Voice: Mr. Chairman, I would like to comment here that having experienced this, I would not like to recommend it. We tried to do a quiet little study in the Men Teachers' Federation of twenty children who badly needed remedial help through programmed materials. By the time we found and distributed the materials for these people, we had fifty other volunteers -- these are children in elementary school. We now have about four mothers writing and visiting, and three or four letters a day from students wanting to get in on the course. My solution was to leave town and come to Ottawa because I'm not just sure what's going to happen when we give these children the opportunity to choose. Now, I'm going to go back to a very traditional, repressed system like we always had and forget about this free choice very fast.

Dr. McLean: Well, that's one expression.

Voice: You just can't handle this kind of thing. We just kid ourselves; and you fellows that are drop-outs yourselves and living comfortably can see the shadows on the wall. If you're going to learn about gardening go and sit in the garden. Go and sit in the public school for five hours and all of you will be sadder and wiser. Some of you industrial barons -- get a year off and come in and run a school. You could do a grand job. But we're kidding ourselves, tying up thousands of dollars in money, sitting here and making ourselves feel all excited. We're not at the issue, we don't know what the issue is anyway.

Dr. McLean: Now you've put your finger right on it, haven't you? And you've trapped yourself.

Voice: Sure.

Mr. McLaren: You say that you can't handle these kinds of challenges. Well, it's because you haven't tried. We're not yet concerned fundamentally about trying. We haven't even begun asking ourselves effectively: "What are we trying to do?" People keep using phrases like "control in the classroom", "the process of teaching", "increasing the clerical load on the teacher". Well, what are you trying to do anyway? Is it teaching you're trying to do? Or is it facilitating learning? As I said before, trying to create an environment within which the individual human being's experience of achieving is being continuously optimized. I don't think you're trying to do that. I honestly don't think you're trying to do it, because you haven't bothered yet, in any serious way, to get down to the philosophical fundamentals, whether as groups or as institutional processes, and you have a lot of them going for you at all levels right up to the politicians, God bless their little pointy heads. We have not as yet, as a society, started to play this fundamental game. And, interestingly enough, the whole business of goal-choosing is being done, but it's being done de facto and after the fact. The kids are going to do it. The kids are doing it all the time anyway. Somebody asked, when we were talking about the drop-outs, and inserted the phrase -- at least the hippies' interpretation of drop-out -- "what statistics have you got?" Well, you have the statistics, in terms of your figures on underachieving within the system right now. You have the statistics, if you want to look for them right now.

Voice: May I bring this panel back to earth for a moment or two? The gentlemen have been talking about what it is we want to do in education. I assume that most of you have read Bloom's Taxonomy of Educational Objectives. I assume that most of you know that two aspects of this have been dealt with pretty thoroughly, namely, the cognitive aspect and now the affective aspect. And I suspect that most people who are talking or dreaming about technology in education are concerning themselves mainly with the cognitive aspects insofar as effectiveness of education is concerned, namely information -- getting information, giving or seeking information. But there are affective factors in individual differences as well. And I don't know how much attention we're giving in this whole computer technology to the affective factors. Now, if you take a group of twenty-five children in a classroom who all have IQ's of 120 to 124 and put them in front of twenty-five terminals which have a cognitive outlook and cognitive objective, how do we know what the affective factors are which will affect what they'll get and what they'll become as a result of all this technology? Now, the question I raise for the panel is, looking in to the very distant future, what is likely to happen in educational technology to such things as emotions and the social aspects of living, if we concentrate our attention upon the hardware and software which deals with the cognitive aspects of our objectives in education?

Dr. McLean: May I suggest that you paint a false dichotomy. What about all these individual differences when twenty or thirty are placed in front of a teacher at a time? All too often, they'd get precious short shrift in that environment too. It may be that dealing with them one at a time, we can do a lot better.

Voice: Excuse me one moment. I think you're a little bit off the beam when you make a difference between a teacher and a machine. Surely, the teacher -- if she's well-trained and knowledgeable -- will be able to do something about the affective factors. What will the machine be able to do about it? (Intermingled voices) Let's not be practical about it. (Laughter) Surely to goodness a well-trained teacher who sees a child in emotional difficulty in a learning situation can do more about it than a machine can.

Voice: Well, we run into a problem. I had the opportunity of talking with Dr. Peore in New York who is quite a big man with IBM. He made the statement -- I thought it was rather shocking -- he said "if we properly sample the population of teachers, they fall into a Gaussian distribution, like everything else." Therefore only fifteen per cent of them are worth their salt. The point I am making is this, that if the fifteen per cent could be expanded into some weird abnormal distribution and these marvellous teachers -- Prometheus -- could do this we would have no affective problems.

Voice: You remember what the Bard of Avon once said: "'Tis a consummation devoutly to be wished".

Voice: But here is where we may compensate for the eighty-four per cent of this Gaussian distribution by giving the children a very highly enriched set of experiences or influences guided and interpreted by teachers and perhaps through electronic methods, through master teachers. As a clinical psychologist, I'm not going to bother with statistics on drop-outs, but I see about a thousand children a year who are cultural schizophrenics. They've spent fourteen years in an educational system -- certainly the teachers have done their best -- and here in this so-called society where the walls have been blown out and we're all a tribal unit and everyone should know everything, they are vincibly ignorant of the world about them simply because they have not had experience. Now, this is a paradox. To live literally in a Persian market of events, experiences, situations -- these children are impermeable, or at least functionally impermeable to the things they need to be human beings. I believe the computer can help here.

Dr. Macdonald: Might I make a comment? It seems to me that the more this discussion goes on, the more we get back to the teacher. And it seems to me that if you want my view of the way that we should proceed with educational technology, it is, focus it more on the teacher than the student, but at least equally on the teacher. You're not going to improve the interaction between student and teacher in classrooms of whatever kind you think of unless you educate the teacher to see the meaning of this, and I think this has been one of the weakest links in all the curriculum development that's gone on in the last fifteen years -- that we started with content and curriculum and then we suddenly decided that maybe there was a child to be educated and then finally we decided that there was a teacher in there somewhere. Now, I grant you that all three have to be integrated but it's the teacher who has had the least spent on him as a member of society, as perhaps the most important or nearly the most important member of society, and I think that this is where a lot of effort has to go. Should we go right into the schools with this technology initially? I pose this question seriously. Should we? Or should we think more in terms of focussing on the teachers at least equally.

Dr. McLean: Well, I think that's great, but the student has received even less attention than the teacher. I think students deserve equal time; that is my point, and that is why we describe our effort as research on the "student-teacher-computer team in education", in the hopes that we won't lose sight of either the student or the teacher. Both these ingredients are a necessary part of this mix, and maybe we are hoping that by keeping that up there on the wall, so to speak, we won't get too involved with the computer.

Voice: One thing that bothers me is that you people are totally unprepared for the sociological problems that develop in the community where this type of technology is used. You take your low eighty-four per cent, you give them technology and they happen to surpass the doctor's and the lawyer's kid, who comes over, mad as anything, and they say "why can't my kid get this? I pay taxes". And boy, you are in a sociological hornet's nest. Now, as psychologists interested in learning, we think that's all there is to it. Boy, when you start fooling around with this, you will be in sociological problems, you'll be screaming for sociologists like blue murder. And we should be approximating these things in small distances, and finding the problems before we push on to a national basis. You fellows will be sorry that you ever touched it unless you see what can ensue.

Mr. McLaren: May I speak as a sociologist? I am staff sociologist, with Air Canada. Let's go ahead and do this, and let's have these problems, because the process of having the problems and dealing with them is a process of learning. And if you back off, and say "Oh, my God, this is going to make a mess and we are going to squander resources", and so on, you are not going to allow yourself the luxury of learning, and you are not therefore going to be able to devise, in an on-going sense, more effective answer systems.

Voice: Yes, but on what scale?

Mr. McLaren: On as large a scale as possible. It's going on anyway. The problems are occurring; some of them are occurring because you are not willing to act. None of us have thought it out on a fundamental basis, or at least we are not yet willing to do this. Perhaps the real problem at the base of all of this is that many of us are still talking in metaphysics, searching for an ideal system where no mistakes will be made or possible. This is philosophical foolishness. If we used systems engineering and its philosophical base, which I suppose is basically existentialist, then a lot of the fundamental problem of searching for ideal situations disappears. We don't know what the social goals beyond the year 2000 are going to look like and there is no point in trying to visualize even predictively in terms of immutables.

Voice: Don, the metaphysics comes in in having the faith that you can live with the aftermath.

Voice: Mr. Chairman, I would like to talk practicalities for a moment, and I would like to address Mr. Menear. You seemed to have arrived at something which was overwhelmingly successful, and yet you are backing off. Now, are you afraid of something or what? Why, why are you running away from this? What's wrong with these other people wanting to join? It looks as though you have something going for you. Perhaps you could give us more information about it.

Dr. Menear: I would be delighted. We can do anything we like in a school community as a public school principal as long as there is no backlash; when there is a backlash we are out. We have no funds. For seven years I've been working on this. This year 12,000 men teachers made a $200 grant, so I could look into this. This is the kind of backing we get. Now some of you chaps look at $1000 as nothing. In the elementary school, the cupboard is bare. We get what we can get spread over seven or eight years and then fear that something will blow up. This is a very difficult situation. You fellows can fly away; we are stuck with it.

Voice: Yes, but you say there are lots of youngsters clamouring to get in on this but you don't provide for them.

Dr. Menear: I supplied 50 more volunteers, which of course we shouldn't have, and I still can't supply the demand because this means 70 people have penetrated the community. This is raising up 140 possibilities because the neighbours on both sides want it too. I can't cope with this on $200.

Voice: It's a financial problem.

Dr. Menear: Right, it's a financial problem.

Mr. McLaren: I made an aside here a moment ago and they've asked me to say it out loud. You are accusing us of flying away. Well, we can't fly away. We are as stuck as you are. We are stuck with your product.

Voice: Isn't the best thing about the situation, Mr. Menear, that your community is so upset that they'll put up the extra money?

Dr. Menear: Well, there are rules; we are not allowed to approach the parents. I'm going to apply for you as foreign aid.

Voice: May I suggest that perhaps you should get some of the other parents on the board?

Voice: I think this raises a interesting point, though. We're seeing pretty well all the very meager research funds in education poured into institutionalized research, represented mainly by OISE. Now, I'm not against this, but there should be money made available for extra institutional establishments.

Dr. Menear: We do approach the Canada Council for grants. They just look down their noses. They hear a teacher -- "We've got nothing for you". You ask the Atkinson Foundation for money -- the board member taps you on the shoulder and says: "Look, don't ask for this money, this is going to embarrass your local board. They'll think we're a bunch of old farmers." We're up a creek, my friends, and the only thing to do is be a drop-out like you have and get a nice desk somewhere and get away from the kids and let the country go to the devil.

LAUGHTER AND VOICES

Dr. McLean: I saw a hand in the back there. Dr. Abbey was seeking to speak. Maybe the OISE should get in another lick.

Dr. Abbey: At the moment, Les, I'd like to make a comment, but not because I have to work with you or even because I'm involved at the Institute. But it seems to me absolutely absurd to hear people talking about concentration on any one segment of what Don has described as the needs to be looked at by the systems approach. Isn't it nonsense to have people here who have just come from other conferences where they talk systems theory, where they talk about having to look at these other problems in the broad social context -- to come here and almost mouth obscenities, in which you say you've got to concentrate on the teacher or you've got to concentrate on the equipment, the child, student, the machine. This is nonsense. You can't single out one element of the system.

You've got to go and look at the political situation just as much as you have to look at the little tablets on which people make responses. I think that if we take each of these segments out and lambaste it, as we're doing, we don't come any closer to the problem, and I'm amazed that anybody would bother coming to a conference who feels that such panelists are going to talk absolute nonsense. That seems to me a nonsensical statement. We represent a great many different kinds of disciplines and interests and the plea for interaction here ought to be heeded, I think.

Mr. Miedzinski: Les, I would like to side here with Dr. Abbey, since he pointed out what certainly needed pointing out, that if we really are talking about the systems approach -- and I don't see anything else that we should be talking about -- then there just is no problem in principle. The problem exists only in practice. In other words, it's wrong to say that, for instance, people talking about technology in education are concentrating on the cognitive approach versus affective side of it. If they really have in mind a total systems approach, they are not concentrating on anything except achieving the final objective. Now, the two problems are: first, decide what the final objectives are; and second, what kind of a system will meet the final objectives. The question of how much emphasis to put on the cognitive or affective side of it will be solved in the process of designing a suitable system, because it's an inherent part of that process.

Mr. McLaren: Well, don't try and design a system which will allow you to achieve final objectives finally, because by definition within the systems approach, this is nonsense.

Voice: Why shouldn't you try?

Voice: This is a kind of am umbrella. We typically resort to the term "systems approach" and I guess we imply thereby that a multitude of agents or components that are functioning in some relationship with each other. Now the trick is to manipulate the identifiable components so that desirable purposes are achieved efficiently. This still does not dismiss the responsibility and task of identifying the more powerful and the less powerful components within the system and establishing the functional relationships between these components within the system. And this gets back to generally hard psychological and procedural questions, and therefore your comment, sir, about teachers being one and the same components will have to be reckoned with in some fashion. Now, the second dilemma I sense is that you're going to have to begin somewhere. It's one thing to conceptualize a system or an idea, as we are now doing by and large; it's another thing to start at Point X in System Y and do this particular thing. Now, there you need a kind of flow chart of steps and phasing in and phasing out; and here come the hard questions as to whether you focus upon the teacher first or primarily, and the learner secondarily or vice versa in whatever constellation of strategies you eventually invoke in some systematic way. So the tough questions still remain with us and just to say that we need to devise and pursue a kind of systems approach to these problems, which I agree with, does not solve the problems, does not remove them by any means.

Dr. McLean: Well, I would remind you that our continuous attempt to solve the problems will still continue after coffee in the individual discussion groups and I would hope that some groups might, in fact, devote themselves to some corner of this system or at least to the whole system and help us out. I have dropped out at the place where we're supposed to attack these problems. I am on that line, not running a school but trying to operate some research. Please send me your notes after the discussion groups. Thank you very much.

QUALITY OF EDUCATION AND THE NEW TECHNOLOGY

Chairman - Dr. J. Macdonald
Sir George Williams University

Members - Dr. L.M. Smith
Simon Fraser University
Dr. D. Abbey
OISE
Mr. G. Thompson
Northern Electric
Mr. B. Gorrill
Encyclopedia Britannica

Dr. Macdonald: I have noticed that the initial letters of educational technology, E.T., can also stand for Extra-Terrestrial, and I would gather from the interventions this morning that some members of the audience feel that this is a good adjective to apply to those of us who are not classroom teachers. I must say that it seems to me that we have already had Panel No. 2 this morning. But the topic is sufficiently vast to produce an almost interminable discussion -- too vast, in fact, to structure very easily. I am therefore going to allow the members of the panel to follow individual paths without suggesting any particular sub-topics for them. I do, however, want to take advantage of my position to make a few introductory remarks although, as I think, they will seem ingloriously trite. The history of technological development carries three lessons for those who are willing to attend to them. First, whatever is used will also be abused. Second, resources that are in limited supply will be differentially distributed. And third, revolutions can't be made in limited sectors of society.

Let me discuss these three points for a moment, with special reference to educational technology, and then I shall invite to the panel to take over.

Educational technology now offers us, in principle, the possibilities, dimly foreseen as early as the Eighteenth Century, of doing whatever we wish; and, in principle again, it is capable of changing the schools out of all recognition. I could list the most likely changes in detail, but, because of the shortage of time, I shall mention only four of the less obvious.

First, educational technology will destroy the traditional concepts of readiness and maturation, with cataclysmic effects on curriculum. Second, it will, because of the new facilities for simulation and objectification, change the nature of theoretical discussion in education. Third, it will force the creation of intellectually honest schools and teachers. When a student has immediate access to unlimited information on any topic, his conclusions are not easily controlled by teachers and educational institutions. Fourth, it pushes the entire education system in the direction of self-service education, a concept now represented only by the library and not always even there. But -- and this is a very important "but" -- while it offers all these possibilities and many more, it also offers an exceedingly dangerous possibility, that of ultimate control of information, and even of the nature of access to information. It should not be a particularly difficult matter to design a system into which only that information is fed which promotes a particular value system; in which certain additional information is accessible only to approved persons; and in which punishment is defined as withdrawal of access. And, if it is not a difficult matter, my reading of history tells me that attempts will be made to design systems of this kind, behind a screen of plausible reasoning.

My other two major points I shall not labour. But, since educational technology does not, of itself, solve social and political problems, I think it very likely that the resources of technology will be distributed in a manner which accentuates the differences between the schools of the poor and the schools which our children attend. Nor do I believe that the present society, including the business corporations which produce the new machines, is ready to absorb the young people which an education system, animated by technology, can -- again in principle -- produce.

Now, after these, as I said, ingloriously trite comments, I shall give way to the panel, the members of which will speak in order as seated. On my immediate left, Mr. Thompson from Northern Electric; then, Dr. Abbey, from OISE; Mr. Gorrill, from Encyclopedia Britannica; and finally, Dr. Smith, from Simon Fraser University. I will ask them to speak for not more than ten minutes apiece in order that there will be time left at the end for them to hack away at each other if they so wish. I should add that, of course, participation from the audience is always welcome, and that, if the "Ontario Mafia" cooperate as they did this morning, we might have quite an interesting discussion. Mr. Thompson:

Mr. Thompson: Thank you, Dr. Macdonald. My first question is, did you miss the morning session or lunch in order to prepare your presentation so well? The second question I have is have you ever worked in a large corporation, sir, because I suggest that we live in precisely the kind of communications environment you have described?

Dr. Macdonald: I have worked in a university; what's the difference?

Mr. Thompson: Not too much, I suppose. In many ways communications environments are manipulated today. I recall a chap at A.T. & T. who wrote a book about life in a phone company. It was supposed to be a novel, but one could identify real people from A.T. & T. all the way through the book. In punishment, they took his telephone away; they didn't fire him, they just cut him off -- ostracized him. I wouldn't fear these things too much, for they are actually with us today. They're not quite so recognizable, but for instance, the structural stability of any large organization is in part due to the managed restriction of information flows within that organization. So this fear is of something already here, but with perhaps a different accent.

Now, with respect to the question of quality of education and the new technology, I'd like to suggest that there is essentially no relevance here, and that what correlation there is, is essentially negative. It almost seems that the more new technology that is introduced, the more troubled education becomes. This is somewhat heretical for a technologist to say, but this is the sort of thing I see. When we have to go to great lengths to prove that a new technology or a new medium, or technique of teaching is effective by setting up refined and carefully controlled experiments, in order to see whether or not it works, well, this just isn't the sort of world that technology actually grew up in. It grew up in a situation where just putting a horsecollar on a horse completely changed the way that land was dealt with in the Middle Ages, or the attachment of a metal stirrup to a horse completely changed the way war was waged. Technology usually brings about drastic and complete changes. One shouldn't have to set up these very delicate and precise experiments in order to detect whether anything is really changed. It should be like night from day. Either we're doing the wrong things with technology, and don't know how to use it, or perhaps quality of education is something we can't really define, and so again the technology is misapplied. I am forced to conclude that there is essentially no correlation between technology and quality in education.

I'm sorry -- I haven't used my ten minutes. You said nothing about a minimum, and I'd like to duck at this point.

Dr. Abbey: I don't know quite how to follow George Orwell and his cohort, the sorcerer's apprentice here. Most of you are aware of the tremendous resources that are being poured into education research, and some of this research is directed towards technology. I thought I'd bring you an example of this, and I've worked out a linear, non-branching program on a highly sophisticated learning machine which I propose to present to you in order to illustrate my personal cognitive and affective response to the question before us which is, I recall, Quality of Education and the New Technology. If I may, I'd like to get this system in operation. I thought perhaps I could present the whole program to you in one fell swoop and we can leave it up here. If you don't like it, we can take it away later, but I have to take you through this as my contribution to the interaction of technology and quality of education. So, letter by letter, these are the elements of the program. (Word "RAPE" written on blackboard at this time.) The first letter has to do with Relevance. Quality of education in my cognitive structure -- my organizers -- has to do with relevance. I think that if one is going to talk about the utilization of technology, then talk not only about methods with which one can program stimuli, but talk also about the degree to which you can bring technology into the learning situation as a simulation. Simulate, for the student in the classroom -- whether this is a lab, a technical-vocational school or a university under whatever control you want -- the world into which you are going to place him on graduation. Bring to him the equipment, whether it's a teletype, whether it's a verb, or whatever kind of equipment it is you're using for teaching, and make sure that that equipment is also of relevance in the outside world or don't bring it in. We have very few businesses operating on the principle of Pressey-type of teaching machines. I would therefore argue, don't bring a Pressey-type teaching machine into the classroom environment. Bring in a machine which is similar to the kind he may have to operate in the outside world.

In this connection, let me just refer you to what I think is a significant development in New York State, and I hope it will come to Ontario at some point. This is the kind of activity that's going on under the provisions of the Garrison Law in which school systems are able to lease the air rights above their schools. When you have that kind of legal provision, you also have the provision for making what goes on in the classroom immediately relevant to what goes on in the outside world, because the outside world is up an escalator to the offices above you. And so when one wants to talk about accounting, you do it in the classroom, but you shoot the students up the tube, in effect, and they go and do it for pay, if necessary, in the commercial world in which they may want to work. So I am concerned about relevance, as a condition of talking about quality in technology.

The second letter has already been touched on. It's the A in this program -- and this is Access. Our chairman has already mentioned it; it will be mentioned again, I'm sure. I frankly think that the information explosion is of absolutely no consequence at all. I am more concerned with information implosion. I am concerned with the cataloguing and filing of information and its transference to things like microfilm and micro fiche to the point where it is impossible to scan information, to the point at which it has become almost impossible in computerized library systems to get anything out that remotely resembles a concentrated search. I saw the horrible results at one aircraft company in Long Beach in which someone asked a very simple question concerning a stress formula and punched the buttons and literally got thousands of cards back. And there it was: instant access to nothing. He then had to go and get a budget to have the damn cards searched. Now, that's the situation into which we are now placing our graduate students in many cases. We are now confronting them with systems where all the information is there and all you have to do is ask the appropriate resource person or librarian and it will come back out again, and that is of no quality at all. That's not quality education; it isn't even quality retrieval. So I'm concerned with the indexing of information and what technology will do in indexing, cataloguing and retrieval.

The P in this program stands for Persuasion and here I'd like to invoke all sorts of deities if I could, but let me just comment on one thing. If education and technology are going to talk to one another, then I think we've got to talk about persuasion in the sense that we have to teach students what it is that they're being persuaded to do -- teach them a little bit about the evaluation of media, teach them a little bit about the grammar of technology -- for example, the grammar of film. This is, after all, a form of technology. Teach them a little bit about how to make sense out of what's coming in from the outside world. Teach them about the Arts, teach them whatever else one has to -- but teach them about how information is being presented to them so that they can be critical. I can't differentiate between persuasion and education except in terms of the goals of the communicator.

Finally, the E in this program is the Evaluation of the whole system. I think if we're going to talk about quality of education and its relation to technology, we must talk about evaluation. This means, I think, that we must talk about a comparison of goals, whether set by the system, by the teacher, or by the student, with the output of the system. A comparison process has to go on between what we want from a system and what we actually get. I think technology is getting in our way. It is far too easy to ram examinations through instant scoring devices such as a Digiteck, and far too easy to produce standard deviations and means and Z-scores for students. It is becoming so easy to make a quantitative assessment that, regardless of how you try to articulate what it is that you're about, you no longer are confronted with the urgency to create an easy way of measuring this. If you can sit down with the student and spend enough time with him personally, maybe you can make a personal evaluation. But technology is now providing a method -- too many methods -- whereby one gets deluded into the notion that you're actually measuring what you originally set out to do. Maybe we could come back to that later. I think there's a real block at the measurement end here. My solution to this is to do away with report cards and certification, of course, and go back to anecdotal report cards. Then, rather than saying that Johnny has an average of so-and-so, tell his future employer or the future school board that Johnny has had these kinds of learning experiences. You don't know whether he learned anything but he has had these kinds of experiences. You might say, "he tends to be rigid when you talk to him in matters regarding politics, but he's extremely flexible in inter-personal relations. He can't add worth a damn, but he's great at getting other people to do jobs." Maybe that's the kind of evaluation we need.

Dr. Macdonald: I find your use of sexual metaphor very interesting, Dr. Abbey. Do you mean to imply possibly that there's no hope of a conventional marriage between technology and the school?

Dr. Abbey: I just want to know which party's which. No, I use "rape" in the Latin sense of "to seize and carry off".

Mr. Gorrill: Mr. Chairman, Ladies and Gentlemen, after seventeen years of being directly involved in education as a teacher, principal, audio-visual lecturer and school inspector, I come to the conclusion that I know very little about education, and therefore I become somewhat inhibited of talking about education. However, my experience in the topic we have today is somewhat limited, and therefore I should be quite uninhibited in what I have to say. There's always the temptation at a time like this, for someone who's left education in the ordinary sense, to come back and try to tell his colleagues how to clearn up the mess -- what they should do. However, I came here to learn and my approach to this particular situation is not to indicate a series of answers or statements that would solve the whole matter, but rather there are a number of questions that I should like to ask. Perhaps when the answers are formulated to these questions, some of the problems which face us today can be resolved. After having had the opportunity to look at schools in many countries both here and in Europe, these are some of the questions. The first question is: who is to be taught? I think you'll find many answers to this. Some provinces have kindergartens, some do not, others have junior kindergartens. Some countries take the children to school at the age of two and a half or three. There are community colleges. In some jurisdictions, there is provision for fast learning; in some cases for slow learning. Sometimes something special for the retarded; at others something for the emotionally disturbed. In some areas you find continuing educational programs for adults. I think we should take a look at the learner. Who is this person whom we are going to give all this to?

The next question I think is, "what are we going to teach these people or what do we expect them to learn?". I think when you identify the learners, then you can perhaps indicate appropriate goals, appropriate behavior, or appropriate things for these people to learn. This, of course, brings up the third question: "how are you going to bring this about?". Is it going to be an individual process or are you going to use a team approach or is it going to be an activity-discovery approach? Are you going to use electronic devices to assist in this process, and if you are, how can the hardware and software be provided? Who is going to pay for it? Will it be paid for by the local people, the provincial or the federal departments?

Another question that seems to be answered in different ways in different jurisdictions is, "who is going to create the software -- will it be a branch of government or will it be private enterprise?". Who will train or retrain the teachers? Will it be the universities, will it be government or will it be industry? I think that when we've arrived at some answers (perhaps the answers would have to be governed to a particular situation in which the person found himself) we may then say how well have we taught the pupils, or what is the quality of the learning situation, or what is the quality of instruction. I think the answers to the first three questions place us in a situation where we can talk about quality. It appears to me that if we have some idea of where we're going, we'll have a better idea of knowing when we have arrived.

Dr. Smith: It seems to me that the big question concerning quality of education and the new technology lies in an answer having to do with control over education. And I'd like to ponder with you for a few moments about this factor of control and some of its dimensions. Myself, I'm pretty frightened about the big mergers that have been occurring in the last eighteen months or so, particularly in the U.S., among the hardware and software industrial companies -- you know, the IBM, Xerox, etc., etc. It seems to me that these people are going to be in a most desirable position to make decisions about curriculum over which the teachers, the parents, the social groups in particular localities will have very little control. And my question here is, with whom should this curriculum control rest? Is industry in a position to make these decisions for us about what our children will be taught in schools? If not industry, then who? Yesterday, coming out on the plane from Vancouver, I was reading the B.C. Province, the Vancouver morning paper, and on the editorial page found a very remarkable thing printed. There were two articles juxtaposed; the one had to do with the conditions of life in countries behind the so-called "Iron Curtain" and the various restrictions on personal liberties imposed there. Right next door to it was an editorial item on the proposed new science curriculum for elementary schools in B.C., and in the paragraph right next to the article on life behind the Iron Curtain, there was a statement to the effect that the new curriculum proposal would be put before the provincial government for approval within the next three weeks. I just about leaped out of the airplane, because I don't believe there is one person in that provincial government who is in a position to make any intelligent comment about what should be taught in the schools. Now, I'm not making any biased statement about the particular government that is in power in B.C. -- please! But I know that control rests with government-elected officials. Should it rest with the teacher? Knowing the array of individual differences among teachers and their general lack of training for making curriculum decisions -- I would not wish to see this.

Some people, under the guise of progressive education, are passing the buck to the student -- let the student make the decision about what he will learn, let him program himself. I think this would result in a remarkable pooling of ignorance in the school generation coming forth. So please don't ask me who I think should make these decisions -- I don't know. But it's a big question mark in my mind.

Second, I think we have to think about control over the learning environment. You realize that, so far at the meetings at this conference, I've had the feeling that many people are thinking of the application of technology within the conventional school setting. Let us think about this. Is this the best environment for learning, using these media? We could electronically educate everyone right at this moment, couldn't we? We've got the equipment. We could produce the programs in very short order. But the architecture of our schools would prohibit it. And yet the new schools that are being built are following the same pattern. So I ask this question: "Should we be considering having schools any more?" Perhaps the quality of education could be greatly enhanced if these new technologies were built in along with the refrigerator and electric range into every household so that the child could learn this kind of content -- the information side of his education -- in his home, and go to some sort of social recreation centre for group discussions and such afterwards. I think that with the introduction of these new technologies, we have to consider the new roles of the schools in society, the new role of the teacher in the learning environment, and the new role of the parent in the education of the child.

Because with these technologies, my guess is that the parent is going to have to play a much greater part in assisting the child to learn, than he does at present.

Third, I think we can look at certain research controls that need to be built into the system. First, we have to define what we mean or what is meant by the requirements of fairly specific learning tasks. At the moment we give children work to do in school with very little idea of what requirements this task places upon the individual learner. This is one research query that should be going ahead in education. Similarly, with the learning procedures. If reinforcement is good we must consider when, how and for what purpose for each specific bit of content. We have to apply what we know about learning to the whole programming of content. And third, we have to drastically overhaul the evaluation methods that are used in schools at the moment. People are trying to use the new technology and they're spoiling the quality and effect of the education because they're superimposing, like a conventional umbrella, the traditional methods of evaluation -- you pass or you fail; you get an A, B or C. And one of the assumptions, I believe, that underlies computer-based instruction, or any kind of instruction that adapts to individual differences, is the notion of 100 per cent learning in the case of every individual who makes the attempt. Therefore these traditional methods of evaluation are quite irrelevant. We have to devise new models for evaluating the student in the context of the new technology.

Dr. Macdonald: Enough points have been raised, I think, to form a basis for discussion and the members of the panel are now free to react to each other or to points raised by the audience. Perhaps I could get things going by asking Dr. Smith why she feels that the kind of system she describes will involve parents to a greater extent than the present system. The logic of this I didn't quite follow.

Dr. Smith: Well, I can see that many of the learning tasks that currently go on in a group situation in a school become individualized and there is no reason for the student to go to school to do this. You could have a computer output in a learning centre, in the home for example. Therefore, parents would be participating, perhaps on an adult education program, with the students. There would be more integration of educational attempts within the family.

Dr. Macdonald: Well, this seems to me then to return to the point I made about the likelihood that these resources will be differentially distributed. There are many homes in our society into which it would not seem feasible to fit technological devices of the kind you suggest.

Dr. Smith: This would be solved, if they were supplied by the government.

Dr. Abbey: I get the feeling that what a couple of us have said up here is that "The quality of education is not planned, it falleth as a lucky card by chance".

Dr. Smith: If I might just pursue discussion about education in the home. There is an example that I know of which has been working for ten years. It is an application of technology to education, just like this. In the outback areas in Australia, they have a radio system where education is conducted by a teacher in continuous conversation with many students who are scattered over many square miles, and the students can communicate with each other and with the teacher from their homes through this radio system. They put a closed circuit T.V. system in there as well, and they've really something going for them.

Voice: Why didn't you do it with the telephone? It is there. It is in -- what -- ninety per cent of the homes across the country now, higher than that, I guess. We haven't even got telephones in classrooms. No, the class is talking about civic government; then phone the mayor. A piece of technology -- give it to people and they won't use it. Now I don't think it's a question of not being able to afford to put it in the house. I think if you did put it into the house they wouldn't use it.

Voice: To a limited extent I would go along with this idea, but on this subject, I'm preconditioned as we all are here and, frankly, I have just got to get out of the house to go and do some work.

Voice: Cabin fever.

Voice: I don't think it is practical to consider doing away with central locations. Perhaps the secret is to create more of these. Where you don't go to the same school everyday. Where you get more opportunity for dynamic human reaction. You make the rounds, but for goodness' sake don't try and send me to school by shoving me up in my bedroom for five days a week. Then this is hopeless. I'll accept a certain amount of limited application of this sort of thing, adult education, evening classes, this sort of thing, maybe a little bit here and there, but this is not the way we have got to go at all. Surely, technology can create more time for us to be able to interact with more people, more different people and to travel further. Aircrafts are a very important part of the educational system of today and tomorrow.

Dr. Smith: So why waste time walking back and forth to school?

Voice: I want my forty days in wilderness.

Voice: Well, this is a very good question, but there are such things as keeping fit.

Dr. Abbey: If no one else wants to comment, I can't buy the kind of categorical statement that Dr. Smith makes about schools not changing. There are model schools and new structures evolving through the Education and Facilities Laboratories, and the people in Ontario and the Toronto School Board are doing enough work to suggest that there are radically new ways of building schools and of bringing modular construction together with things like closed circuit T.V. and telephone systems. There are new models for physical plants and there are new models for integrating communications systems within these. And I think the quality of education is better because of these new models -- is better in the sense that if I set a goal for an education system which is that people will investigate as many sources of data as possible before arriving at a decision, then I think children are being exposed to systems that allow them to do that. When my seven-year-old comes home and says, "Daddy, we were at the Resources Centre today" and I say "What in hell is that" -- I just came out of his school, and I know there is no Resources Centre there. He says, "Well, the principal took us into the new wing." Well, the new wing now has the top girder on, and so the skeleton is there, so the principal took him and his class out of Grade Two and marched them through the new building and showed them that this is where the Resources Centre is going to be. I said, "Fine, great; what is going to be in the Resources Centre?" "We are going to have tape recorders", he said, "and filmstrips and we are going to have -- I don't think we are going to have any scissors and paper." And then he went on and enumerated a few more things in the Resources Centre. Well, that is going to be a better quality of education. Whether it is going to perpetuate the political order; whether it is going to do a better job of socialization (which I guess means that the youngsters don't overthrow the old political order) or whether it is going to mean less incidence of suicide, I don't know. But it is going to mean, in my terms, at least a possibility of more relevance. It is going to confront kids with problems of where to get the information to solve other kinds of problems what have just been posed. So I don't buy the concept that we are just dealing with a stack of old brick school houses.

Dr. Smith: I think you have to be careful though -- you just said a very significant thing. How do you solve the problems that have been posed. Now, I think we are in the business of having to train the teachers in a decidedly new way. I know one very modern school built on this modular system. A traditionally-taught group of teachers went into that school. Do you know what they are doing? They are buying hardboard partitions to put up so that they can get conventional classrooms in there. So this will be quality! But facilities can provide quality, if you have the right human influence.

Voice: I would like to go back if I might, to some philosophers who are now dead: Max Plank and Hans Grech, who talked about mechanism and vitalism. Remember they cut up the atom in four parts, thinking they had discovered something and what they got was little wee organisms instead of a big organism, but fully formed. I have the feeling that we are trying to cut up a big idea of education and technology to conquer it, and all we've got is an awful little idea. I think we are trying to solve problems of vitalism using mechanism. Is this right? And if so, why are we doing it in this way?

Dr. Macdonald: Well, I think that before answering that question, one would have to know what is meant by problems of vitalism.

Dr. Menear: What is the essence of human nature and how will you cultivate it using technology?

LONG PAUSE

Dr. Abbey: Well, I'm young so I'll try an answer. The essence of human nature is that it's mobile. The essence of human nature is that it's investigatory, that it's curious, that it wants its belly full, that it tries to solve problems when it recognizes them, and that, if you present materials, that it can investigate and bring together materials and try out a solution.

Dr. Macdonald: You could equally well say that the essence of human nature is to make a mistake, if it's at all possible to make a mistake.

Voice: George Orwell could say that.

Voice: Not only George Orwell. In fact, it's one of the principles of instruction, isn't it -- or at least one approach to instruction -- that children should have a good deal of freedom to make mistakes. Right?

Voice: How do you define a mistake?

Dr. Macdonald: Well, a mistake always has an element of subjective definition, doesn't it? If a child adds up one and one and gets three, then he is wrong, because we have conventionally determined that one and one make two, and this I think is true of a good many mistakes. They are subjectively defined by adults and teachers. However, the sort of mistake I am talking about has a much less subjective element present. All I'm saying indeed, is that given the resources of educational technology, it is likely from what we know of human history that these resources will be used wrongly and unwisely. Now, they can be used wrongly and unwisely in a variety of ways. One way, I would gather, is to use them essentially to do what we are doing but do it more efficiently. Another way is to employ educational technology basically in order to produce greater control of individuals. And don't forget that when one talks about a controlled learning environment, this is what one means. Now, if you want a controlled learning environment for the teaching of, say, arithmetic, this may be all very well. But if you decide you also want a controlled learning environment for the teaching, say, of political ideas, I think this starts you into some very serious and basic problems. It's interesting that all the examples we've been given so far of the use of CAI is with respect to subjects like reading and arithmetic. Presumably computer-assisted instruction is capable of development which would enable it to handle more complex data. Now then, this immediately faces you with the problem of what to put into the programs. And from what I know of teachers, school boards and commissions, governments, etc. leads me to suppose that these groups would have a very serious interest, and not always an objective interest, in what goes into these programs, not to speak of the business corporations, which have their own interests.

Voice: Isn't that just as true under our present system, John, as it would be under computerized technology?

Dr. Macdonald: Not quite, because in our present system it's possible for a student to escape from the system in a variety of ways. In fact, it might be argued, and some people have argued, that children essentially educate themselves in the interstices of the system. But in the sort of system that we are now thinking about, there will not be any interstices.

Voice: Yes, but are they really saying that? This is the other thing that we haven't addressed ourselves to. What percentage or portion of education is reasonably and legitimately thought of as this kind of education? It seems to me we've been skirting this problem quite a bit and we haven't actually considered it explicitly.

Dr. Abbey: You don't really want a percentage figure, do you?

Voice: I want this question considered. Whether a percentage comes out of it or not, and I won't want a precise figure. It's nonsense to ask for a precise figure, as you know, but the question has to be considered.

Mr. Marineau: I would like to ask one of the panelists the question -- "Who has the right to decide about the quality of education?". It seems to me that the only difference between our country, where we have democracy, and some others is that we can have the privilege of selling an idea instead of imposing it. It also seems to me that we can decide many kinds of things within our school system. You say, "Now, we will do this" and so on and so on. We can sell it to the parents, we can sell it to the students, because we have good means of communication for the selling of things. I'm wondering who has the right to sell this?

Voice: The School Trustees and the Minister.

Dr. Macdonald: I think I would like to ask each member of the panel in turn to react to this question.

Dr. Abbey: Let us try an economic model. It seems to me that up to a couple of years ago, education -- with respect to this question -- was operating as a kind of monopolistic establishment, where you had relatively few people in a position of control in terms of deciding content, and of setting goals, and where any competition occurred between separate school boards and public school boards. It occurred, let's say, between the old guard and the new guard, but still within the system. What I think is happening now -- which brings your question to focus perhaps -- is that we've got some new competitors. We've got industry -- not that education isn't an industry -- but we have an industry whose basic motive is profit. And I think there is a new kind of competition here in which the old ideals are being put to the test. Now, frankly, one of the reasons that Dal Smythe and I don't talk to one another -- at least I don't think we do anymore -- is that I suggested to him that he ought not to have a Master's Degree program in communications because it was obvious from everything he said that he was concerned with the fact that the mass media could do all sorts of horrible things to kids, that the advertisers could do terrible things to children through television and that we have to train our graduate students somehow to do research in this area. And I said, "Dal, why not take all the money that's going to go into your Master's program in communication and give it to the ad agencies and let them teach about communication." He didn't buy this, not for one moment. Now, I think we ought to let this thing be fought out in the market place, frankly.

Dr. Macdonald: This, it seems to me, in its way is as antique a model as the other. I've just been reading Galbraith's book on the New Industrial State, in which he has some very sharp things to say about the free market model. In fact, a free market does not persist for very long simply because one of the interests represented succeeds in overpowering the others. And one possibility which has been mentioned already is that in this context the producing corporations will be able to determine what, in fact, is taught. Is this an eventuality which attracts you?

Dr. Abbey: Yes.

Dr. Macdonald: Then I'm very much on Dal Smythe's side. (laughter)

Voice: Mr. Chairman, there's a point I'd like to raise here. When I went to school, all my textbooks were published by very large publishing organizations. I recall they were pretty well all written by practising teachers. Has the position changed today? Does industry have in fact some method of controlling what goes through them apart from the quality control?

Voice: Perhaps I can indicate some answer to this question. I think we have to look at the situation as it is in most of the provinces and I think that the statement that industry controls education can only be made by someone who is not aware of the facts. Within each province you have a Department of

Education which determines who will go to school, when and where. Whether they delegate this responsibility to local boards or not, it's still a provincial responsibility. They decide what will be taught, and when textbooks and so on are written, they determine which of these textbooks will be used. It doesn't seem to me that industry has much of an opportunity to dictate what happens in the schools at all and that it would seem to me that the purpose of education is to maintain our society as the representatives of the people determine at the provincial level, the members of the legislative assemblies who delegate this responsibility to professional educators who are hired for this purpose.

Voice: My suggestion is that the textbook is becoming and will become much less important than it is now; that even textbooks are being less written by practising teachers than by professional writers and, more important, that the media and the products are being produced by companies. The Science Research Associates produces a tremendous variety of elementary reading materials, and when you say that the province has control, they certainly do, but they must select from what is available. The provincial governments write very few things and at the present time produce proportionately little material. Now, my point was that some attention ought to be given to the systematic evaluation in techniques so that this variety can be examined carefully and also that some production can go on outside of the establishment.

Dr. Smith: It's important too, I think, that the extent of choice, even commercially produced, should be maintained. When you get into computer programs for instruction, it is such a highly expensive operation to produce these programs, that you're going to get your range of choice narrowed within which the provincial governments must select. This is where the control factor is.

Voice: Well, I'll accept this, but the point I'm trying to make is I think it's a red herring to say that industry has any significant control over what is coming out. It is a free market position; we have no real control. There's tremendous competition.

Voice: But it's also fair to say that industry in protecting its own future is taking great steps to make inroads into certain areas. In at least one province in Canada -- I think there are more -- you can't use cablevision without renting lines from a large telephone company.

Dr. Macdonald: I am told that the time has now come to draw the panel to a close. If the panel has succeeded in isolating any question of importance, it seems to me it is this question of control, and you may wish to carry on a discussion of the question in your small groups later. Just in passing, let me say one thing. It seems curious that we should use the rhetoric of political democracy to describe schools which are not by any stretch of the imagination democratically-run institutions. With that remark, I shall close the panel.

TECHNOLOGY AND INSTRUCTION FOR TOMORROW

Chairman: Dr. G. Nason
Canadian Teachers' Fed.

Members: Dr. M. McClaren
Simon Fraser University
Miss M. Gayfer
School Progress
Dr. H. Stein
U. of British Columbia
Dr. F.T. Tyler
University of Victoria

Dr. Nason: As Chairman, I would like to suggest that we should not quibble about the term "instruction". I would like to ask the panel members in the scope of their remarks to accept a very broad interpretation of this word, so as to include any means that may be used to bring the student face to face with the matter to be learned -- whether this confrontation is achieved through personal performance by the teacher or through his rather less personal structuring of a learning situation, and irrespective of whether it be done at the kindergarten level or at the level of advanced graduate studies.

Our panel has been carefully selected for the uniqueness of the contribution each member can make to the discussion this evening. The panel members include a Professor of Biology, an Educational Psychologist, a Journalist, and, of all things, a Dean. Our plan is to begin with a five-minute statement from each panelist, then to provide them with a brief period for haggling and heckling, and finally to turn you, the audience, loose on them. Our first five-minute statement will be made by Dr. McClaren, Assistant Professor of Biology, Professional Foundations, Simon Fraser University. He is involved in audio-tutorial laboratory systems in the bio-sciences.

Dr. McClaren: I'm in the rather interesting position of being both a "so-called" pure scientist and also someone who's involved in the Professional Foundations Program within the Department of Education or Faculty of Education at Simon Fraser. In this dual role I have an opportunity both to talk to school teachers and school officials and to use a rather simple technological system in instruction in freshman biology. The simple system that I refer to involves only the use of audio-tape, super-8mm film loop projectors, with appropriate written material, including some programs of a rather simple sort. This system has attracted great interest in B.C., so I have had the rather edifying experience of showing a great number of school officials, school teachers and others through this laboratory; (a) to see how it works, (b) to learn how much it costs, and (c) to decide whether or not they could use one like it. The main concern that comes to my mind as I speak tonight on a panel on Instruction, Technology Tomorrow and Beyond is how we are going to get technology into the classrooms and, in fact, whether we're ever going to get technology into the classrooms at all. True, we have some sorts of technology in the schools, at least in British Columbia, right now. We have tape recorders, film projectors, and various sorts of audio-visual equipment; but we have very little of it in each school. In freshman biology, for example, we use sixty-four tape recorders. I have been in schools with sixteen hundred students and sixty faculty members in Vancouver that had only two tape recorders. Therefore, technology -- even the limited technology of the past in simple systems like tape recorders -- is there, though really not being very widely used. In a great many cases, what we have tried to do when we talk to teachers and when we show them through our laboratory is to point out some things that they have at their disposal right now -- things that they might possibly use right now, while waiting for the more sophisticated equipment. Our hope is that, if they start to play around with technology on a simple basis, they may see the possibilities in it. Of course -- and we have to accept this -- they may reject it entirely. But at least they're going to get involved in it to some extent, and they're going to try it out. So, for example, we point out to them that generally they have commerce classes in their school which use dictaphone machines which can be put to other uses, believe it or not, and all of a sudden they find that in fact this is true! Many schools in Greater Vancouver are now having language laboratories installed. These can also be used for other purposes. Teachers are beginning to realize this and are beginning to experiment with the technology they have. They aren't sold! They haven't bought it! All they're doing is starting to play around with rather simple technology on a broad basis. And I think we must be aware that if we're going to give the teachers the right to make this decision about the technology -- and I think it's important that we let them make an honest decision -- then, as scientists or as partial observers (or whatever), we've got to be prepared for them to reject it, as well. They may say: "It just doesn't apply."

Dr. Nason: Thank you very much, Dr. McClaren. Harry Stein is the Director of Graduate Studies in the Faculty of Education at UBC. Harry is an Educational Psychologist, and I should like to ask him to give us five minutes from his experiences.

Dr. Stein: The theme of this evening's discussion is "Instruction Tomorrow", and this word "tomorrow" worries me a little bit because I want to be sure that we all agree on what tomorrow is. I have a feeling that we really have more concern with what is likely to transpire tomorrow than with what is transpiring today, although Dr. McClaren has told us some of the things that are happening in British Columbia. So, I suggest to you, ladies and gentlemen, that one of the most serious problems facing the users of the so-called new technology is the adaptation of the new technology to our current objectives, such as they are, in the teaching and learning process. Mr. Miedzinski, in his very good paper, has outlined a sequence for these objectives -- all of which are pertinent today, and some of which may be pertinent tomorrow. But I have a feeling that because, as he implied, changes will be startling and rapid, some of the objectives we meet tomorrow may not be the same as some of the objectives we meet today. Because some of the new instrumentation such as ETV and language labs and audio-visual aids to instruction, the older -- pardon the expression -- teaching machines which are now being collected in basements all over the American continent by the thousands are being replaced by newer machines. If we consider electronic video-recording and other technological devices as potential elements in a new order of teaching tomorrow, I think we would have to say that there are not too many difficulties in the way of adapting them to today's needs. However, how can we be sure that the objectives of tomorrow -- and when I say tomorrow, I mean thirty, forty or fifty years hence when the generation that we are bringing up today become the teachers of tomorrow-- will be the same as the objectives of today? However, should Marxism and Maoism find their way into our culture or into our political ideology (heaven forbid), it may not be necessary to teach for free thinking and individual freedom. It may be necessary to adapt our teaching and our objectives to an Orwellian society of some sort. We don't know what's going to happen tomorrow.

Remember the film that we saw last night? The thought has occurred to some that if and when we have produced a generation -- and again, heaven forbid -- that has been brought up solely by means of hardware of the kind that we've been talking about, there is no way of knowing what kinds of programs these people will produce for their children. They will have an entirely different sort of ideology, I suspect, from that which we hold.

Now, we who are in teacher education activity are constantly giving thought to the school of tomorrow. We can't help ourselves -- it is forced upon us. In our programs in the philosophy of education, the methodology of education, and the technology of education, we're aware of some of the potential changes our teachers will be facing. However, because our provincial universities are at the mercy of the provincial governments insofar as their sustenance is concerned, we find it extremely difficult to keep fully abreast of all of the possibilities deriving from the new technology; and we're lucky if we can put teachers into some of our schools with any technology, let alone with any ideas as to what might transpire in the next twenty or thirty years. And we would be quite happy if we can put teachers into our schools who are even modestly adaptable to the changes for tomorrow. So I would hope that, as a result of conferences of this kind, Mr. Chairman, we can spark enthusiasm among those to whom we are responsible for the things that we do in our teacher training institutions and in our schools, and then there may be some hope for the instruction of tomorrow.

Dr. Nason: Thank you, Harry, thank you very much. Our next panel member, Miss Margaret Gayfer, the editor of School Progress magazine. Margaret is quite clearly the best-looking member of the panel. I think she struck a blow for the reputation of journalism too, in that she's shown a certain canniness in not making her notes, as the other panel members, on Skyline notepads and therefore one might assume that she has prepared her remarks some time in advance.

Miss Gayfer: We seem to be on a continuous conference circuit which I call the "psychiatric couch of the educator"; there seems to be a demand and, hopefully, a use in people coming together to suggest and exchange some of their views. One of the workshops I was at delved into the great question of goals. It was suggested that the goals of education were both arbitrary, subjective, and, I thought, "good". This is exactly the way I feel, both arbitrary, and very subjective. In one sense I feel like saying: "What a nerve we have to be discussing technology and tomorrow and all that", because there seems to be the suggestion that nobody quite knows what technology is and we're questioning even what tomorrow is. I got involved with some of this when I did a report in School Progress on Education in the Future. First I had the idea -- wouldn't it be interesting to try to write something called "Once Upon a Future" -- about what the school system would be like in the future. One of the ideas that came to me was that instruction as we know it will be the first drop-out of the school of tomorrow. I started thinking just what education would be like in, say, the year 2000, for Johnny So And So. What would he be doing? Where would he live? How would he learn? I found I could no longer keep it to education; I became curious about what would be happening to poverty; what would happen to pollution; how would transportation be operating; what kind of a city would he live in; what kind of building; and where would his food come from? I found that no longer could you just think in terms of how somebody would learn. I was trying to project into another type of environment, like predicting a kind of Utopia or News from Nowhere. It became so involved, mainly because

I couldn't think of the terms to describe some of the things that might possibly take place, that I gave up trying to write this story of what would happen to a child taking part in a learning process in the year 2000. This is quite possibly what is happening to education and what is so confusing -- education can no longer be in this tight little box. This is one of the things that is bothering a great many people. Many can hardly wait to retire because they feel that this is all happening too suddenly -- "let me out of here" -- even people who are very excited and interested in the future. There is a much wider field for education now -- and the corny phrase, of course, is that "the walls are coming down", etc. There is a more total picture now and the educator and the teacher and the student each has to see himself in a much wider context when he thinks in terms of education or instruction or learning for tomorrow. When I was compiling the article on Education and the Future, I was reminded of the 15th Century which is the beginning of the humanist philosophy and of the curriculum concept. Now, I began to think that if so many things can be done through other means, such as retrieval of information -- not retrieval of knowledge -- then we could well revert somewhat to the medieval system of the tutorial. You would be able to get information through some means of technology and the meeting with the teacher or the tutor, would be the great highlight of your day or of your week. You would have this meeting with a human being after you had retrieved your information from diverse sources of media and thought about it. There would be a great sense of joy and anticipation at having this dialogue with the teacher. This made me think more and more of the interaction of the so-called machine and the human being. We've talked about technology. We've talked about various resources and it still seems that there is a point at which these two interact. Hopefully, the human interaction would be the most valuable part of the instruction and the learning for the student. In the same way that in the whole broader context of education's interaction with all kinds of other interactions and developments in the world, those in education could provide just as exciting an interaction.

Dr. Nason: Thank you, Margaret. I would like to introduce to you Dr. Fred Tyler, probably one of the busiest men in the conference. I note that he has been asked to be a recorder. Having been trapped with that job once and having vowed never to be stuck with it again, I suspect he is doing a terrific amount of work in that capacity. On very short notice he has also very kindly agreed to provide the balance for the panel this evening, when Dr. Knowles of York University was unable to come. So from far out in the Pacific area, I would like to introduce Dr. Fred Tyler, the Dean of the Faculty of Education of the University of Victoria.

Dr. Tyler: Thank you. Now, the Chairman has made it very plain that I am a substitute. He commented on this a couple of times and as you all know, the definition of a substitute is "one who isn't as good as....". This being the case, I propose not to be bound by either the topic or the time limit. Furthermore, as a Dean, I sometimes think it's rather interesting to be involved in instruction. The topic was technology and instruction. I'm not really sure we have a topic here. The orator of communications, McLuhan, has said that instruction is out, and discovery is in. However, because I am white, Anglo-Saxon, middle-class, I feel I have to cooperate and fill in at least for five minutes.

A few years ago I was asked to prepare a paper for the California Congress on Teacher Education on programmed learning and teaching machines. I was asked to prepare this paper because the president of the association that year knew that I was pretty critical and rather negative about programmed learning. I was concerned for a number of reasons. First of all, I wondered whether programming for people really did follow from pecking by pigeons. I was quite convinced, in fact, that the psychological theory did not lead, necessarily, to programmed learning. Then I was also concerned about linear programming, you know, just one answer, and that has to be an obvious answer too. One answer and one reinforcement. There had to be no error learning and the pupils never learned to ask questions. It seems to me the important aspect of learning is learning to ask the proper questions. If you can go back to thinking of teaching geometry, for instance, once you get the youngsters to ask the right questions very frequently they could go ahead and solve the exercise. I was also concerned about this kind of learning, one response, one reinforcement, no errors. What would happen to personalities? Also, would it lead to a high degree of conformity? I rather felt that it would because if you have Walden II, you will remember that, in a visit down to Walden II, Skinner describes the person going around meeting the various people, and one question was: "Well now, do you people down here take any part in politics?". And the answer according to Skinner, Skinner's theory and Skinner himself, was: "Why, of course, we have a group of managers; they analyze the issues, and they tell us the answers, and we go down and vote the ticket."

Now, I think however that there have been some changes in this matter of programming in the last ten years. Programming to me, it seems, has become much more flexible, much less rigid. I think that it has been demonstrated that programming can develop quite a variety of psychological skills. One of my students, now at the University of B.C., showed that youngsters in the elementary grades could indeed be taught by programs to ask questions. I was a little skeptical about this, and I said, "But of course you will get them to ask questions; you can teach youngsters to do that. They are cooperative. They'll ask questions if that is what you want." "But", I said, "they are going to be irrelevant qurstions." Well, it turned out I was right on one count -- he did teach them to ask more questions -- but I was wrong on the other. The questions were relevant. Also Crutchfield and Covington -- Covington was another student of mine -- are working on the development of creative thinking by means of programmed materials. They had something like a quarter of a million dollars to develop the general process of creative thinking and they are now beginning to apply it to specific school subjects.

Again, under the linear programming scheme, only one answer is possible, really. Otherwise, you know, you are turning papers backwards and forwards and turning the book upside down, and so on. But with computers now, many more responses can be put into the computer, and so I suppose all 500 proofs of the Pythagorean theorom could be stored in the computer and if any youngster comes up with any of these unique solutions, the computer will be able to tell him that he is correct. However, I think that technology is more than the computer.

It seems to me that some of our difficulties today, and some of the disagreements and some of the heat, was engendered because we were not thinking about the total range of technological developments. Too often it was computer assisted instruction, instead of computer assisted instruction. Now, I think that there was also the criticism that computer system instruction is concerned only with certain kinds of things, because only subject matter has been very extensively developed as yet -- reading and arithmetic, for instance. And I suppose these had been developed because it is a little easier to formulate a systematic sequence of events. I don't think that anyone can come up with a specific sequence for teaching youngsters to interpret metaphors as yet. Maybe somebody will sometime.

I think we have to consider seriously all aspects of technological developments as far as instruction is concerned. Now let me introduce a little jargon. Individual differences are so great in cognitive structure that we just have to get some ways of capitalizing on these individual differences; not reducing them or eliminating them, but capitalizing on them. Our society needs all the talents it can possibly get.

I have used the term "cognitive structure" and I suspect that you think I don't know any examples of that. I heard a little story down in Montreal at the AUCC the other day, told by Meredith Wilson. This minister came to town, and was a real hit. The Rotarians were very enthusiastic about him and wanted very much to get him into the association. But they already had a minister and, as you know, the Rotarians can have only one member from each occupation or profession. So they puzzled over how they were going to get him into the Rotarians. Well, they had one vacancy, one occupation vacancy -- a hog-caller. And they didn't know if they could go to the minister and ask him whether he would join in this position or not. Finally, they decided they should because they really did want him so badly. So they asked him. He thought for a minute and then said, "Well, you know, I am usually called a shepherd, but I suppose you know your people better than I do". Now I said I was going to use that to illustrate cognitive structure. The Dean of Education at UBC was sitting beside me and he happens to come from England as you may remember. He said, "What was the point of that story? What has a hog-caller got to do with this?". Now, with his English background he knew about hog collars but not hog callers. One of the examples used today was used because it would fit into our common structure, I suppose. There are cognitive styles too, and we need to take them into account and so we need also to look into ITV, blackboard by wire, and microfiche, and so on. And there was concern today whether a microfiche wouldn't make it possible for somebody to determine what we would be able to read. You know if everything is on microfiche cards, and you don't put it onto a microcard, how are you going to be able to read it? Well look, that sort of thing is going on right now. I even learned today that the Kinsey Report is under lock and key in the University of B.C. in 1967. Right?

Voice: Yes. At least it was the last time I looked.

Dr. Tyler: I think that in Canada we simply have to do a little more about research, and among other things, I think we need research and development in connection with these technological developments.

(NOTE: Here the technology broke down and there was nothing on the tape for about three minutes. A break in the record illustrates both the stage we are in in technological development and how far we have come. Records of voices can now easily be kept for posterity. Wouldn't it be interesting for an education student to hear a lecture by John Dewey, Alfred Binet and others and even watch them delivering it on film?)

Dr. Nason: Harry, you raise the intriguing question of just how adaptable teachers can be. I rather gained the impression from your brief remarks that we may be destined to have a teaching force that is always a generation behind because of the teacher's own background and education. Now, if this is so, I think we're in serious trouble in pretending to plan for tomorrow. I think it is interesting that no very extensive reference was made by any of the panel members to the use of technology in teacher education. Perhaps I am doing some of you an injustice. Would any of you like to make a comment about this?

Dr. Stein: We've had almost every modern form of projection technique in our teacher education setup for a long time. And we have, I suppose, one of the better ETV setups. We have taperecorders and teaching machines. (I think it was in our institution that the famous limerick about the teaching machine was invented.) I'm sure you all know this famous limerick about the teaching machine, so I won't repeat it. It's in every textbook that was ever written about teaching machines. And the only thing we do not have yet -- and simply because we can't afford it -- is a computer in our own building, but we will have an outlet in our own building attached to the central computer in the university and we are giving programming computer courses to our teachers in training right now. We are on the way and it's going to take a long time before our computer organization is finally developed. But like everything else, there has to be a beginning somewhere.

Miss Gayfer: I'd like to ask you,what schools are they going to teach in? I've talked to a lot of superintendents of schools, board chairmen, teachers and principals about technology. I've been asked things like "do you think we should buy an overhead projector?". Big deal! This is where they're at! I often use a phrase, "how about the price of prunes?", in the sense of "let's get down to the mundane matters of what is happening right now in the classroom". You've raised the question of where the money is going to come from for research. But where's the money going to come from for even buying something as simple as an overhead projector, let alone a computer or tape recorder. We're even talking about retrieval systems here. All this is fine for the select hundred that are here, but what about the practitioners?

Voice: Let me relate something we discovered. In conducting a professional course, we were thinking of a program which would teach teachers how to make their own 8mm films, which is really an easy process. We were going to buy a professional model camera, a super 8mm camera, when someone said, "It's no use, because they'll never have a professional model super 8mm camera at their disposal so why not just buy a movie camera and teach them how to use that to make their own films?". We did this with great success. I think this is why you have to start down at the tested level and get them going on that.

Voice: I would just like to make a comment to Dr. Stein about teacher education. When you are reading books in other disciplines and they are discussing -- Dr. Kaplan who did some work in Israel with mothers concerning the way they brought up children and their training procedures found that regardless of the intellectual input, that is, the best things we can put into their heads, they tended to bring up their children in the way in which they themselves were brought up. Therefore, I would submit to you that it is important that the teacher be taught the information you wish her to impart in the way you want her to teach instead of the teacher being taught how to program. It is her receptive state that is important, rather than the technology. Similarly, a discussion of Nuffield at the Science Convention where the man said, "I know about this; I am helping to work it out; I understand the theory and I know what they are doing, but these children are handling problems which I can't handle because I have not gone through the process". I think this is the crux of the matter in education -- to go through the process.

Dr. Stein: I'm quite sure you're quite right, but the problem is, how do we get the people who are most concerned with it to adopt this kind of ideology? This is the big problem. Do you realize that we're just as conservative in teacher education institutions as all the teachers in schools today; and it's just as hard to move teacher training institutions as it is to move teachers in schools.

Voice: Well, my point is that this is where the prime effort should be made; to move them in the teacher education institutions.

Dr. Stein: I couldn't agree with you more.

Voice: We've listened for several hours on technology and this is really the first time this evening that we've talked about human beings. The young lady who just had the floor, I think, had the right idea. She's talking of human beings and this really is what education is all about. We're talking, not of technology -- technology is an aid in education -- but of people. It's living individuals that we're talking about. We're talking about the mainstream of life; we're talking about communication one to the other, the older generation telling the younger generation what they know and what they don't know and admitting their faults and realizing what can be done the next time around. Communication, stimulation, involvement -- are we involved with the people we're teaching? And honestly we've got to say, "are we involved with it?". This is what education is all about. We're talking to people and communicating ideas and we have to be part and parcel of those ideas. We have to believe them and have to show those people the direction in which they should go.

Voice: I want to refer to the question the young lady raised, about training teachers with these media so that they could instruct with it. It is a point that was raised this morning in one of the study sessions. If this whole conference has to do with instructional media, how can we expect teachers to use newer media without having been prepared to use it?

Dr. Nason: I'd like to underline that particular point. I think my own profession probably stands to be condemned in this regard. I believe we're going to have to make some radical changes, because I have been at many meetings and conferences of teachers where there hasn't even been a blackboard.

Mr. Billowes: I'd like to take up Margaret Gayfer's point for a moment. I think perhaps she's the only one who has moved into the area which I like to think of as tomorrow, not the next three years of the current teacher training course, but the far distant future. And she's painted a picture which I think merits some thinking. I'd like to put it this way -- and it's a provocative challenge to you -- that if education doesn't get off the pot, we in industry who have vast educational problems and are applying the latest technologies to these problems are going to set up our own schools to the extent that where, one day, if we don't want to send our youth to your schools -- it's already being seriously suggested to me that we set up the University of Northern Electric. Now, let's look ahead and see this happening. Because education has a monopoly today which is traditional; it is not there for good. In future it may not exist in the current institutionalized form we have today.

Voice: If you look into the literature -- and I don't think you're aware of it -- if you look into the literature of the United States, you'll find that approximately eighty per cent of all the money spent on education in the United States is not spent in the schools; it 's spent by industry and a great many other organizations. But you see, you're not producing the facts. The Boeing Corporation -- someone in one of the papers which I have in my brief case noted that there's no use being made of programmed instruction -- the Boeing Corporation in Seattle has had a programmed instruction program for the indoctrination for their own personnel and for their own procedures for the last ten years, and they've done more with programmed instruction than any school I know of.

Voice: That's not really a very progressive mode you've suggested. It sounds really exciting, but it's not really very progressive because it's still institutionalized, and whether you have it at Simon Fraser University or PS 76 or at Northern Electric's plant wherever that may be, it's not really a very progressive model. There's more education going on outside the schools right now than is going on inside them anyway. And in another twenty years, thirty years, I really doubt that the little red schoolhouse is going to be around at all.

Voice: What will it be like?

Dr. Crawford: My point has been passed. It related to the fact that people were worrying a little bit about this teacher gap; the generation gap in the teaching profession. I think there are hopeful signs, but I don't think they necessarily come from technology. They come from the student involvement such as the laboratory approach to mathematics and science, but particularly in England. This is not a new thing of course, but at least we're beginning to see that we can teach via pupils themselves and in small group and discussion work. After all, the students are teaching each other and there is great hope for the future, because as these people grow up, this is the kind of thing they have been doing.

I don't think that it's right to say that there should necessarily be a generation gap. Certainly it's up to the teacher education establishments to do something about it, and I hope that the new MacArthur College at Queen's which goes into operation this fall will start as it means to do and not accept additional methods courses in teacher education. It will need to be very selective about the practice teaching aspect. This is one of the things that I'm very concerned about -- that the teachers who work with us in producing new teachers are going to have to be teachers in whom we can have confidence as being experimental in their outlook and attitudes, and I think "attitude" is one of the words that we want to get across.

Dr. Nason: Ladies and Gentlemen, I am going to exert the Chairman's prerogative. I have a feeling you are ready to discuss this subject now and this has been the main function of the panel. I'd like to thank them on your behalf.

PRACTICAL CONSIDERATIONS

Chairman - Mr. D. Morton
Dept. of Education, Alberta

Members - Mr. J. Hanley
Dept. of Education, Ontario
Dr. H. Pullen
Ottawa Collegiate Inst. Bd.
Dr. Jack Murray
Metro Toronto School Board

Mr. Morton: You know the names of the panel and you have something of the biographical data which has been supplied to you. I should say at the outset that if there is virtue in spontaneity then we have it here this morning. However, I thought as was mentioned earlier that a chairman has some prerogatives and I propose to exercise those to provide a framework. I am going to use an acrostic too, but because I come from Alberta I would not dare to use the one that was used by Dr. Abbey yesterday. Even P.E.T. may be regarded as somewhat dangerous from the point of view of the prairie morality. However, you may be interested and surprised to know that in connection with our Alberta Pilot Projects on Educational Television, the Alberta Government Telephones developed a production package which is being leased as teachers' PET and this stands for Portable Educational Television, which I think is very cute. I'm using it here as Practical Educational Technology. I'm going to use the letters of the word "PRACTICAL" to provide the setting for you.

Arising out of our discussions in the last day or two, there are certain key words, it seems to me, key ideas which it is time now to focus our attention upon in realistic and practical terms. First of all, there is the question of Priority, setting priorities of need. Obviously, when one considers the total spectrum of educational technology and the total needs that are present in both the educational establishment and in society, we can't do everything at the same time. One of the first practical considerations is to determine priority. These can be expressed as Purposes. We have talked a good deal about aims and objectives in the light of planning. These kinds of things can be done in very limited ways in small areas, or they can be done in very broad general ways. I'm not sure whether you are acquainted with the current issue of the British "Science Journal", but there are a number of excellent articles on Forecasting the Future. One article in particular deals with the matter of technological forecasting and how it is used by large corporations. There is also a suggestion that other segments of the community can use the techniques of technological forecasting and it seems to me that these are techniques that we cannot afford to overlook in the educational community. The R is for Research, obviously, and again I think this is what this conference is all about. Research has to be future-oriented but it also has to be down-to-earth and Realistic. I also think that it has to be Realizable which probably is saying the same thing in a somewhat different way. I think that here we must think of research in its micro-sense, as well as in its macro-sense. We have to have subjective research as well as objective research. I think that we need to analyze the old research to see what has relevance, and to engage in new research. The next is related to Action. In order to initiate action we have to have some Administration or Authority. Somebody has to do something about something. Whose responsibility is it? It is at Administration that the buck stops. Now is it the CEA, the Council of Ministers, the CCRE; is it the Departments of Education, the Faculties of Education, the colleges, who actually initiate action in this regard? We must put all of these in a setting, and so we think obviously of Children. Somebody earlier made the excellent point that we cannot neglect the fact that at the centre and heart of this whole topic are human beings. Educators are rightly occupied with children, but they are moving toward -- and as a matter of fact, are presently thinking of -- society generally. Education is not just for kids anymore; it has to be thought of broadly and in a continuing fashion.

The next are Teachers, mediating people, but these days we are not only thinking of teachers but of those who help teachers and work with teachers. So we can't overlook the Technicians. One of the great gaps from a realistic and practical point of view is that in Canada, as elsewhere, we do not have educational technicians and educational technologists. From a practical point of view this is one of the things we must look at. We can add Training if you like, to the T's there, because this is something else that we lack very much. In the I category, the role of Industry has been emphasized many times in this conference, and as I think most of us are aware, this must take into account very definite and direct involvement. Several other I's would be Instruction, Individual Differences, Inspiration, and Innovation. The next one is the question of Cost and Costing, thinking of it in terms of accounting. We have now arrived at the point when something has to happen to this curve of educational expenditure. Certainly nothing is more practical than costing the elements of technology out with relationship to all of these other items in our list. Next, we have another A and here I think there must be a change of Attitude. This is very practical because you don't move unless people's attitudes or mental set is directed towards what is necessary. After Attitudes have been considered, then there must be an Adjustment in people's thinking right from the ground up as we enter more and more upon the technological society. What about the L? Well, my word is Logistics, which in the most practical terms is how we accomplish purposes. What are first steps, second steps, etc.? How do we combine the cash, the research and the sense of direction that we may have engendered?

I'm not sure that this exercise was useful, but it was fun. I believe very much in involvement and participation. So if you have other words which you wish to add to the list you're perfectly welcome to go ahead. Whether this has been useful insofar as introducing the panel is concerned, I have no knowledge. As I said, this was spontaneous and unrehearsed and we'll carry on in this way. I'll ask Mr. Hanley, of the Ontario Department of Education, to take over.

Mr. Hanley: I can only make a few comments relative to my own experience as a very recent teacher in the classroom. It seems to me that one of the most practical considerations here, relative to technology and its introduction into the schools, concerns the teachers who will be using it. I think that perhaps we can discuss the teacher attitude to technology with reference to certain fears that they may have. Many teachers are out of touch with what's happening, not just with what's happening in education in terms of new technology, new methodology, etc. But I've actually seen many teachers who are just out of touch, and consequently they find themselves in an upsetting situation. They see students coming to class with information and ideas that they don't have. An example of this might be a certain teacher who told me that he hadn't gone to a movie or watched a television program for thirty years. This is just a little thing; but it is important that children are coming to school with ideas that they're getting from these media, and this teacher does not know what the students are talking about. This must be a very upsetting situation. This sort of teacher strongly endorses the rigid type of situation found in most classrooms today because they can control the content by means of the prescribed textbook and, through authority and discipline, can control the way in which this material is being fed to the student. Now, we're concerned with individuality. We're talking about individualized instruction. We're talking about allowing the classes to group and so on. To such a teacher this is chaotic. He was unsure of himself even in the other situation, but at least he was in control of it. So he's afraid of this new unstructured format, and I think that's one problem that's going to have to be considered.

The idea of the student and the teacher learning together is another concept where many teachers feel insecure. Another problem that we face arises since the new media inevitably break down the walls between the various disciplines. Now, this again is a very upsetting situation for the particular sort of teacher that I'm talking about. One of the things that he takes refuge in is in the integrity of his own discipline, and if he's going to be forced to delve into other areas and to allow the student to explore such other areas as his inclinations lead him -- and I don't see how the new media is going to do anything else but that -- he is again unsure of where he's headed and is not prepared to cope with this uncertainty. Again, such teachers may fear the new technology because they don't understand it and they don't know how to use it. We're talking here about highly sophisticated systems, and computer-assisted instruction. I just cane from Peterboro Wednesday where we were in a long involved discussion about the overhead projector. That's just two hours' drive from here. They were concerned about the overhead projector, let alone taking a movie into the classooom -- and educational television to them is something that's completely exotic. They neither understand the new technology nor what their role will be in using it. They feel very vague and uncertain and are afraid that the sooner they embrace the new technology, the sooner they'll be superseded by it. It was suggested in one of the discussion groups yesterday -- I think it was Dr. MacDonald who suggested that new structuring of teachers may very well develop where there will be a cadre of highly trained teachers and specialists in audio-visual and technological materials. I think this is quite possible and I think this is what some of the teachers are worried about -- that they can't handle this material. They don't know how to use it; it leads them away from subjects. They're very sure of themselves in a very narrow area of History -- British History, they know their British History well -- but all of a sudden other relevant problems are coming in as a result of the study of British History and they're very unsure of that. They don't like this and they want to retreat back into the other secure world. Now, a fear that is a very common one, and one that we all have to consider, is that the computer will tend to dehumanize the educational experience. I must say, in my ignorance, I share this fear, that it frightens me that when people begin to say we completely individualize the instruction to the point where the student is isolated from the group. In one of our discussion groups, it came out quite strongly that the student needs communion with his peers and social groups and tutorials and so on. Now, it may very well be that this is going to be, and I'm sure that those of you who are developing computers are thinking in these terms -- I'm sure you are -- but it's not being made clear to the troops, and I think it has to be made clear. And I add that the machines don't have to dehumanize at all; they can be very helpful by freeing the teacher and allowing him to work in this very important interpersonal relationship with the students in groups and with the student individually. Don Thompson and I have worked with films, using films to assist the students in the development of self-knowledge, insight and understanding, and I'm hoping that computer-assisted instruction will encourage the student to go and gather more knowledge about himself and about his relations with his peers and society in general. I want to mention the fear of the administrators. There are people in this province who are afraid of anything that's new unless it has been pre-accepted by the social situation in which the school finds itself. The thing that some principals fear most -- at least this is the impression that I get -- is a phone call from a parent, relative to some kind of instruction that is going on. He's afraid of it, and I suppose you can't blame him. The comment has been made to me that once a principal's name gets in the headlines, his career is finished. Well, this may or may not be correct, I don't know. So when you say "let's do this", I'm wondering if they're ready to accept it. I think then that a number of responsibilities have to be accepted. Obviously, the teachers' colleges have an important role to play in preparing the teacher for his new role and for the greater use of technology. That has been underlined time and time again at this Symposium. Teachers' conferences are being held regularly and can contribute. I think that the people who have gathered here for this conference, who know their field and who are in the process of developing these systems should go to those conferences and talk to these teachers. Again we have to talk to parent-teacher groups to convince them that what is being suggested and what is being developed is not Orwellian. I think that one of the things that we in ETV have recognized is this very same thing. We're attempting to do this now by creating regional coordinators and talking to school boards and parent-teacher groups relative to the use of ETV and I feel that this is being very helpful.

Mr. Morton: Thank you, Mr. Hanley. I think you have brought us down to earth and certainly there's another man on the panel who I think is a past master at bringing people down to earth, and we will next call upon Dr. Pullen from Ottawa.

Dr. Pullen: Mr. Chairman, ladies and gentlemen, I belong to the group who are very close to earth -- the school superintendent -- and I don't know just how to talk to you because I am certainly out of my depth in this kind of discussion. I heard a lady say yesterday that she spoke to her trustee and he didn't know what an overhead projector was. I presume the indictment was that there were no overhead projectors then because the trustee didn't know what it was all about. I would like to speak to you from the position of a superintendent -- I think of the group of which I happen to be President -- The Superintendent and Directors of Ontario. There are about a hundred and ten of us and I presume we're "power figures", at least we have sooner or later to make recommendations to our Boards, and we're under pressure all the time. These vary from the kind of statement made yesterday -- if you damn well don't want better schools, the Northern Electric will organize one itself -- to complete satisfaction by those parents who believe that a school is successful if the child passes, because the ticket, then, is in the youth's hands to go to the place where most of you and I became respectable. We went to university. So into the school office come the people, either physically or in the reams of propaganda who will help us to correct the school offering -- make it better, or maintain the status quo. This is one of the problems that I have -- and such problems are sitting around my desk all the time.

There are problems of staff, problems of communication, problems of budget and so on. One of the superintendent's problems right now is this fantastic job of preparing a 20 million dollar budget, and I'm one of the small ones. So I looked up the budget this morning (I got up a little early) and we had on the average (for the young lady) eight overhead projectors in each school last year. Our supplies last year cost forty-five thousand dollars. We rented two thousand films and I suppose we obtained an equal number for free. Last year there were sixteen films per month rented -- now, that's not a large amount but it represents movement. In this year's budget, we will be adding at least four overhead projectors per school. You may well say that's not nearly enough, but for the supply of the related materials, the filmstrips and so on, the budget is seventy-two thousand dollars. Why isn't it ten times that? For the simple reason that one of the other pressures are my trustees who are responsible for the budget, the city council which is responsible for the total tax rate and the people whom you represent who have to dig into their pockets and pay cash for my demands.

Demands I receive vary from those for overhead projectors to a reduction to thirty pupils to the classroom, thirty teaching periods per week, administrative assistants, more psychologists, more school attendance counsellors, social workers, so on and so on. In other words, it's within the great spectrum of demands that we have to consider your particular hobbyhorse. I ask that when you make wide sweeping statements that you remember that it has to fit within the budget.

The most recent pressure I was subjected to was a very interesting one. A fellow came in with a lot of literature, and he fastened those beady eyes on me and said: "You need the black box". It turns out that the black box is an energy-something-or-other, where ions go into the air so that I will become more energetic, if I only have it. Well, the way he looked at me, he made me feel a little humble, because he reminded me of the teacher, for example, the supervisor from your cubby hole that was saying in a loud voice to another library teacher, "library services in Eastern Ontario will not improve until certain administrators retire"; and I have a feeling we get this reputation in more areas than one.

When you come to us with your gadgets and with your suggestions, and many of them are very sincere, we are really confused, because we don't know really whether you're primarily interested in selling your gadget or helping our system. I would feel that some of us should be held responsible, for example, for the language laboratories that we have purchased in Canada; and when some of you fellows are looking for research projects in OISE or elsewhere you might consider undertaking a little practical survey to determine the extent to which the language laboratories in Canada are in full operation. When men come in to sell these to me, I was as illiterate about language laboratories as I am in your particular system. I got some rather strange reactions when I asked one simple question: "Would you please tell me, in the light of the current situation where we have a curriculum, with language being a part of that curriculum, and with a teacher with a class at the present time the unit of curriculum; if I had three hours a week for language for Class 11A, have you any evidence that the use of this laboratory will do what you say it will do?" Will you tell me what it will do? Will it, for example, make a student more fluent in French? Have you evidence that by my spending twelve thousand dollars, that my 11A will be more fluent in French? I'm sorry I never got a satisfactory answer to the question. Yet that's the sort of question we have to ask. What will the service do? Have you evidence that it will do it? Again, unfortunately, when you give us the answer, we don't quite believe you because we wonder whether you're selling us the hardware or trying to help education. Well, this is our problem and I'm not blaming you. I'm simply saying it's a problem. And those of us who are at the end of the rail line somewhere up in Ottawa and not able to get all the wonderful services from the Department of Education, and across the road at OISE -- and thank God we miss a lot of the speeches -- we're groping.

We have sent some of our friends, Minkler, for example, who you can't shut up on educational data processing and yet we listen to Fred with some sincerity. I listen very carefully because he and I share a common fear. We're frightened to death that some day our Board will pay us what we're worth, and that's dangerous these days. Fred is an enthusiast and he's one of my friends who will influence me in this. And again you influence me, but what I need is neutral help. I'll quit, and simply say we're on the bandwagon, if it is a bandwagon.

We're moving along into the new world, if it is to be a new world. I'm not too sure myself whether I'm on a bandwagon, or whether I'm moving along into this brave new world that you're talking about. My budget for next year will be two hundred and twenty thousand dollars of the people's money. That's quite a bit of money. It's a goodly part of my twenty million dollar budget. I don't have the calculator to figure out the percentage, but it's fairly high. We keep attendance, we do grade reporting, we have registration, we are analyzing tests for guidance and psychological departments, aptitudes, counselling inventories, preferences, the Henman-Nelson and so on. We have a 1401 IBM, we have an old-fashioned mark-sensor and I've never been in such a mess in my life as I was this September, but I'll stop here and you can ask me why if you like.

Mr. Morton: Thank you very much, Dr. Pullen. We move along to Dr. Jack Murray of the Toronto Board of Education and his primary concern is that of educational facilities as they may be related to educational objectives.

Dr. Murray: I work for the Study of Educational Facilities in Metropolitan Toronto and we have been attempting for over a year now to develop "User Requirements for School Buildings". We have spent considerable time talking to educators at every level from classroom teacher through to assistant superintendents asking what we thought were straight-forward questions, such as, "What do you do in school?", "what do you need in order to be able to do that?" and we encountered great complexity -- the kind of complexity that has been described so fully by these three gentlemen. The result is personal frustration. As I listen to these men, I have a feeling of wanting to strike out at somebody or something in order to clarify the situation. I think many other people at this meeting feel the same way. There has been some striking out at other groups or other parties to this affair.

In our own project -- we have architects on staff who have come around to the position of saying to educators: "What do you want?" and they say "such and such"; "Well, do you want this?" "Well, we'd like it"; "Do you really think you'd use it?" "Well, that would depend." This goes on, and so after two or three meetings, the architects ask, "Is it true that you don't really know?", and they say "yes" and then the architects say, "Fine; you're certain?" and the educators say "yes". This is a useful exercise for the architects because they can then try to establish the probabilities of some of the possibilities -- the types of space to be used and the types of equipment that will be in it and then they simply maximize on something called flexibility which says you want as little as possible fixed in the buildings.

Now, this is theoretically all very simple, but economically extremely expensive -- in other words, to build for a totally flexible environment is not practical. We simply cannot afford to build buildings when we cannot specify what we intend to do in them. With the diversity in education, and the diversity is increasing, we cannot specify, even within wide limits, exactly what a school program is going to look like. There is major massive experimentation -- with moving around and trying out -- this is good, this is fine, but it is all costing us considerable money. It is also ensuring that we are not getting as specialized facilities as we could get, or as functional facilities as we could get, if we were able to specify exactly the nature of instructional or schooling activities. So I'm pleased to be here to share frustration with you.

I have a number of other piecemeal comments. I was thinking earlier that for some reason or other, practical is generally opposed to theoretical, but in fact practical seems to be too often synonymous with piecemeal approaches. You spread it all out and then cope with the problem that jumps up most day by day. This violates all concepts of long-term planning and all attempts to use the systems approach. I think that education must come to believe at all levels that nothing is as practical as a good theory. I think Don McLaren's pleas yesterday: "Would you please make or construct or tell us what it is you want to do in school or what we as a group should make happen in school" -- are to the point. We can't build buildings around values; we can build buildings around behaviors. You can have whatever rationale for the behaviors you want, but ultimately when people use a place, they do things: they sit there, they jump up and down, they wander around, they group this way or that way, and this is what an environment accomodates. The other thing that people do is to use equipment. This was very simple as long as it was unitary and there was not very much of it. The kinds of complex equipment that now exist and are being proposed, that may or may not be useful, depending on how they're used, these should be accomodated. Should we put in raised floors in the buildings, so that we can place any sort of terminals any place because we don't know how we're going to group them or we don't know what sort of back-up resources we're going to use? We can't afford raised floors throughout the building. Again, should we put in the conduits now because we're going to use television? Well, how much do the conduits cost? When are they likely to be used? If we don't get around to using them for ten or fifteen years, there's good possibility that we won't need the conduits. There's a huge number of other technical alternatives.

Let me just stop there, and make one point or take one position. I assume that we want learning to happen. Dr. Pullen says "what learning?". Well, that has to be specified, but there are certain discreet learnings like reading, writing and buttoning clothes. We want learning to happen. We assume that it must become more efficient; that learning would be more efficient if it were individualized, and if it were more continuous. I think we can make these assumptions. I think we know for a fact that we cannot individualize fully in 30-pupil classrooms; we cannot individualize instruction with the present arrangements -- and the way we now go about schooling. The Toronto Board the other night hired ten special teachers to teach eighty students a year remedial reading. One of our trustees, Dr. Lister, University of Toronto, made a calculation on the evidence about the number of students in our system that are retarded in reading and said: "To apply this as a general solution would cost us over seven million dollars a year." Now, when we're talking about these amounts of money, it would seem we should consider alternate ways of doing it. I believe we must come to consider alternate arrangements for carrying out schooling. We have to "clean up" this thing called "instruction" some way or other, so that we can ensure that it happens; so that we will get a common behavioral output, that the kids read, write, walk straight or have such results on tests. Now, the rest of the socialization, the education per se, the becoming people and so on, may be the important thing, but nobody's going to come around and measure this.

I think we're "hung up". Because you're deflected from your primary goals, you're stymied on this thing called instruction. I think technology applies to instruction, it applies to the business management of the school. Now as for education in the full sense. I think McLuhan is right. Education is in the environment; it's done by CBC, it's done on the streets, it's done wherever people live. And certainly if they live in school, they'll be educated in school by teachers, as long as the teachers aren't trying to perform machine functions.

Mr. Morton: Thank you, Dr. Murray. If I'm correct in assessing the argument so far, comments have been a little biased towards the negative side, insofar as the total situation is concerned. I would hope that in the remaining ten minutes that we have, we might be a little more positive, though not necessarily in the assessment of the present situation, although I dare say that there are quite a number of positive things that are in fact happening, if these were brought together and the information made available to us. But I rather think that it would be equally as important for some practical suggestions to be made with regard to what may happen next. Now, the R & D people are going to be taking this question up after lunch. What kind of R & D, in what topics, and so on. What are the practical things that might be referred to these people. I would feel that if either members of the panel or members of the audience have contributions to make to the discussion, that you might address yourself to some practical step-by-step suggestions which can be taken up and presumably acted upon. Otherwise, we get back into a cycle which is very difficult to break. Does that put you on the spot? I hope it does.

Mr. Miedzinski: Mr. Chairman, I have some practical suggestions to make. First, Dr. Pullen raised the problem that budgets are limited, and that this is an important reason why there is no more equipment in schools than there is now, not the reticence to buy but the inability to buy. Now, obviously one way towards improving the situation is to reduce the costs of what you would like to buy, then you will purchase more of it. There are many things which affect costs, but there is one very simple thing which affects costs considerably and which appears not to be appreciated at all by people within the educational system. This is the strong relationship of costs of production and sales to the amount of information available concerning what the demand is, what the budgets are and what the plans are. In connection with any development proposals as to what my firm should be doing in this area, I recently went through the period of trying to answer the following question: "If the firm does what I suggest, what can be the result, what do the educators have now and what are they likely to want?"; and I found it extremely difficult to get any reliable information. No effort was spared to get it and I'm not talking about information which does not exist, but about the information which exists but is not readily available. Dr. Pullen has just mentioned some statistics that the school boards have. Such simple information which should be useful is not easily available for someone from outside, unless one canvasses the five thousand school boards in the country, and this is impossible. So I'm making an appeal here. Please in your work understand that you can help yourself and reduce the cost of what you are going to buy through making information about what you have and what you definitely intend to buy readily accessible to all industry.

Mr. Menear: I'd like to thank Dick for bringing us the kind of help that Alberta brings. The writing is one the wall. If you looked yesterday, you could see what you can expect from OISE. Now, what I suggest is that we pull the pussy-cat's tail. I think we've come to the point where the technical pushers better drop out, at least for a year or so. We tried five or six years ago to cope with this and the pack rats came in, and I thank the Director of this organization that they're not here today. They came in, took over the organization, Canadian Council for Programmed Learning, completely aborted the desires and we never knew what happened to the money. An enquiry was never held. Some of us have had to wait very quietly and very impatiently. I think the time has now come to suggest to our rich industrial people: "Get out of the field, hang everything on a hook because you don't know which way it's going to go; finance a group of educators, that is, people who are truly educators, people from reputable firms who will put their heads together; then we'll share our secrets with you and you will have, instead of the two million market you visualize, you'll have a two billion market, but it will be shaped by teachers."

I think Dr. John MacDonald had the idea that schools boards, institutions, the professional group itself should shape up the programs and test them and then the copyrights will be held by his institution or mine and we will make this available for commercial distribution, because they know this field, and we don't because we're babes in the woods. But I strongly suggest that the really well financed, forward looking commercial people set up a fund to be used in the development of about ten or fifteen people here from B.C. to the far East. I think it's time to get out and let us develop this thing, and you'll find then the secrets will flow. As it is, people like MacDonald -- and I hope he realizes how vulnerable he is because of his remarks yesterday -- are apt to have a contract slapped in front of them to write a textbook or something so that he won't develop his idea. Now we've lain quiet long enough. We're heading towards a national emergency. We just won't have the hundreds of millions to throw around. If you listen to Pearson's speech in London, England last night, you'll get a few clues as to what's in the future for us. We've got to pull together, forget about provincial and industrial educational boundaries, in this eternal chess game. Last year my boss was taken away from me by one of the fine technical people and about the same time another very fine outstanding educator was taken away from us. In this eternal chess game I'm packing now to move out of my office on the 22nd of December and I hope to become a stimulator -- I'm going to become a journalist. And I'm going to keep on your tails, and if I can help by spreading ideas, I'm going to do it. But this is our last chance to retain identity as a country. It's not an educational commercial. And we can pull together. I see tremendous people in teaching. Why can't educators and industrial people take the lead in pulling this country together and getting the efficiency of investment that we've got to have to survive. Now, I won't say anything more in this whole context; I thank you for letting me exceed my time.

Voice: On a highly pragmatic and practical level I'd like to bring to your attention something that was happening in England, though I'm not up to date on this. In Central London -- you know, London education authorities got together and set up a standards and a testing organization which represents something over a million children, I believe, and a very, very large and powerful buying force. They've realized by setting this up and applying standards and helping to work with industry in their products, and by bulk buying that they can reduce costs immeasurably and I would commend this sort of thing to you. I've done a little in the past at trying to sell in education -- fortunately I'm not at that end any more -- it's a hellish business. If you've got five thousand boards in Ontario you've got five thousand individual selling jobs to do and you've got to prove your case every time. Now, if you in education can take up this idea, and work together, I think you'll find it much more successful.

Mr. Morton: You're suggesting that there are two related functions, the one in setting up standards, testing and providing something similar to a consumers' report operation, and the other one is buying or acting as a channel for purchasing.

Voice: May I comment on that? I think this is a most important thing for us, because there's a difference between a university budget, for example, and a public school budget. We're entirely vulnerable to the business community who clamour for equal treatment. In other words, IBM versus Computing Devices versus Honeywell talking to me -- I'm the key man and I don't know anything about any one of them. So when we finally come up with an answer you'll likely see in the paper tomorrow where my picture is taken beside a machine or something or other, this afternoon we're making a big decision. Now, this kind of thing that you're talking about would help us immeasurably. Mind you, I have a feeling that the buying problem will sort itself out gradually. In other words, we'll gradually move into the accounting and the looking after of the reports and so on.

The point that I'm concerned about more is my twenty-five thousand kids who are going into a data processing world. Now we have made a start with the mathematics and we've got about four classes in data processing who are making simple programs and such. We have two machines of which one of them is technical and we're using some quality control work and such. We desparately need help there too, because all my kids who are going into private industry or the Federal Government are going into a world that was different from ours. In other words, the educational aspect of the new world is of really more fundamental importance to us and we need help both from the industry, from the institutes and from others. We need someone to spend days with the Mathematics teacher, to translate my kind of teaching mathematics, and there are many fellows working in mathematics at my age who taught Theorem 22 followed by Theorem 23, into the new world. You have to help us too if we're going to lead these children properly.

Mr. Morton: I'd like to ask one question of the previous speaker down here. Then there is a question at the back and then I'm afraid we're going to have to wind this up. My question to you, sir, is: "Who do you think might take the initiative to do this?" It's alright to talk about something of this sort being set up. Do you think this is properly the responsibility of CEA, CCRE or the Council of Ministers or who? Somebody has to bell the cat, so to speak.

Voice: I'm not sure. I think in London there was some sort of formal relationship between the schools. There was a cooperative organization of some sort in which this spawned and generated. But you've got to keep people like us (business) out, obviously.

Mr. Morton: Well, there isn't any viable organization that I know of.

Dr. Murray: I proposed in the paper I'm reviewing this afternoon an answer to the question you have. It should be the Council of Ministers and I set out reasons: because it's a national group and it's at least a national question; and because it must be a voluntary operation. You can't legislate this kind of thing. It must be voluntary among the participants and there are several other reasons for suggesting that the operation should be sponsored by the Council of Ministers.

Voice: I would like to bring together two comments that were made, the first one by Dr. Murray and the other by the gentleman by the table. I find it rather hard to reconcile the two statements, that Dr. Murray can't get from the teachers what is needed in the planning of a building. It's a simple case of structure and requirements, and the facilities which will lead towards a new generation of equipment. If you can't get that type of answer at the moment how can you lead the technologists and the technicians out of the system, as is suggested by the second comment? I feel that we must be in this field, but the question is, how do you do it in a non-commercial way. At the NRC, I am trying to raise interest right now in an associate committee, which would have representation from industry, from the universities, from the provincial government and from the federal lads like the National Research Council, because if we really want to do some technical planning, we need a body which has no commercial interest, I feel, in line with Dr. Pullen's comment. You shouldn't be under pressure to make decisions, and the group that I'm with and Brahan spoke of yesterday was put together for good reason. Now, a second comment relates to the dehumanizing of people by machine. This is certainly far from the minds of the people involved in the development, I assure you. For one thing, if you look at the question of preparing lectures in this media, you'll find that the degree of compression in time, due to the thorough editing that you have to do for it, is at least of the order of four or six to one, and as a result of presenting the details of a course very concisely, the extra time, which is quite considerable, becomes available for discussion. Consequently, the humanizing should go up rather than the other way, if you apply it correctly.

Mr. Hanley: I suggest then that when I was outlining some of the fears the teachers feel, these are real fears. You have indicated that there are no grounds for such a fear. I think this is very reassuring. Let's tell the people, then. Let's make sure we tell the teacher in the classroom that there is nothing to fear relative to humanization and so on.

Voice: I would just like to suggest that if you explain to the teacher that this would not become a dehumanizing process and they would feel comfortable, I wonder if they would feel comfortable if they were given time for discussion? In other words, are they skilled in the inter-personal and inter-relating skills which will make them feel comfortable if their prime role is not one of vital leadership in this area.

Voice: In other words, we are not teaching machines.

Mr. Morton: Well, I must now let you go to your groups.

R & D AND THE NEW TECHNOLOGY

Chairman: Dr. W.D. Neal
University of Alberta

Members: Dr. J.-M. Joly
Québec IRP
Mr. G. Miedzinski
RCA Victor
Mr. J. Brahan
National Research Council
Dr. H.J. Hallworth
University of Calgary

Dr. Neal: Ladies and gentlemen, procedures this afternoon will be essentially identical with those which other panels have followed. Since, as you already know, there will not be small-group discussions after the panel, we will try, as quickly as we can, to provide the opportunities for members from the audience to participate and make comment and ask questions. The members of the panel are known to you by name and you have some details of their background with you, so again we'll save time by not introducing them. As the discussion has proceeded during the last two days, I am sure that all groups have edged into the area of Research and Development. Indeed, it would be strange if we had not. But there still remains a lot to be said, and one of the difficulties is to try and decide where one should start. First of all, one might raise questions as to who does Research and Development. We must certainly raise questions concerning the kind of resources we need for Research and Development. We're also concerned, I think, with determining where resources can be most effectively used in terms of input into educational systems so that returns be more comprehensive than obtained so far. For example, would it be better to take one school or one school system, and saturate it with as much in the way of technological equipment as possible and discover what happens when we do all that we can in one total system? Or are we going to be concerned with introducing some technological device in one system and another device in another system and hope that, in the process, we'll be able to put the findings all together? These are all problems of Research and Development. There are many others too. I suppose one positive thing that can be said is that there must be Research and Development. There must be much more than we have at the present time on the Canadian scene, and certainly it has to be coordinated better and made more efficient, with such resources as we have or are likely to have. It's difficult to see how we can avoid having to pool the efforts that we put into this kind of enterprise and into the coordination and dissemination of the results. The panel will speak in the order in which they are seated, starting from my left. We haven't structured procedures very much -- each member has his own thoughts which he will share with you. I think we'll ask Mr. Brahan to make a few comments.

Mr. Brahan: I would like to consider some of the areas where Research and Development is required to implement technological advances into the educational system and perhaps this will result in some comments on what is being done and what should be done in the future. Since I am involved in technology, the first area I would like to consider is "hardware". In this instance, I will use the term "hardware" to include the physical equipment plus any computer programming required to complete the system. That is to say, the devices which the student sees and also the control part of the system which is hidden. The present state of technology is such that a mass of complex equipment is available, but the problem is to assemble the equipment into an effective system to perform the desired function. If this is done in the field of education, it is the responsibility of the educators to tell the technologists what they require of the hardware, and how they plan to incorporate the hardware into their system. If we are to make effective use of the technological facilities that we have at our disposal, there must be effective communication between the educator and the hardware specialist.

In considering the hardware which is available, we find that there is tremendous computing power available today -- computing power which we did not even visualize ten years ago. Today we have very large computers, in effect, multi-computers operating as a unit which are capable of carrying out a large number of different tasks concurrently. We have adaptive computer systems which are capable of "learning". Associated with these computers, we have facilities for the storage and retrieval of vast amounts of information. One major problem area in making effective use of this computing power is in the field of communication between man and machine. Whether it be in the educational environment or in other environments, it is a serious problem. There is a great deal of work going on at the present time in this field, and much remains to be done. Another problem which should be included in a consideration of hardware development is the architectural problem. This was mentioned briefly this morning when it was said that the answer the architect gets when he asks what is required in the school buildings where the new technology is to be used is "I don't know". It appears that much effort will be required to resolve the architectural problems created by the implementation of technical equipment in the school system.

Once the hardware is available, consideration must be given to the preparation and testing of instructional materials which will be used in the system. There has been a lot of work done in this area, particularly in the U.S. Most of this work has been concerned with the preparation and testing of particular programs and courses and has brought to light a number of problem areas. However, studies involving the effect on the total school environment are more rare. For example, what happens to a group of students when they have finished a period of instruction using a computer-aided system when they go to their next class? Their attitude is not going to be the same as if they had come from a class where conventional teaching methods were used.

Another area where work is required is in the field of curriculum development. It has been mentioned a number of times during the conference that a problem exists because the curriculum is too rigid -- it takes a long time to change. But we are living in a changing world where the rate of change is increasing, and if the educational system is to keep up, we have to rearrange our thinking so that the curriculum can be changed to meet the demands of society. The educational system is not isolated from society -- it is part of society; it must move along with society, otherwise it will fail to perform its function.

This brings me to another area which is that of the social implications of technology and education. It has been pointed out during the conference that we really don't know what the implications of technological change are. I am sure that when the automobile was first introduced, people had no idea of the effect it was going to have on our society. It went much further than simply providing us with a means of rapid transportation. It has affected almost every aspect of our daily life. It is in the area of social implications of the application of technology to education that a considerable amount of work must be done if we are to find out what the effects will be from the introduction of technological advances into the educational system. Perhaps it will be necessary to carry out longitudinal studies, similar to the Stanford studies on gifted children, following groups of students through the school system to determine what problems which arise can be related back to the techniques which are used for teaching. The social implications within the school system must also be considered. One aspect is the question of individual differences.. It has been pointed out by various people that one of the effects of the introduction of technology will be to amplify individual differences. What is going to be the effect of this amplification? Can children of the same age group work together even though they cover a very wide range of educational achievement?

There are a number of different areas where work must be done if the full benefits of advances in technology are to be made available to the educational system, and the work will have to be carried out by specialists in the particular areas. Thus there is a need for cooperation between many disciplines. The educator must be aware of the capabilities of the technologist so that he can make reasonable demands for new facilities. He must tell the technologist what the failings are in the hardware that he has been provided. The results of the studies of the sociologist will have to be fed back into the teacher education programs, and curriculum development programs. If effective use is to be made of the limited funds available for research in education (and these appear to be much too limited) there must be extremely good cooperation between the research groups working in the various areas to gain the most benefit from advances in technology.

To conclude, I would like to quote from a paper presented by Ramo in 1957 which I think expresses the responsibility of the technologist to the field of education. "I should like to propose that these very technological advances about which we normally speak when we talk about the new technical society must include advances in the field of education, and it is part of the obligation of those of us who are engaged in the engineering side of modern science somehow to apply ourselves to help the process of education."

Mr. Joly: Mr. Chairman, I thought I would talk briefly, first of all, about some conditions that exist at present which are far from being conducive to good, fruitful educational research and development. Secondly, I would like to mention some very partial solutions -- the problem is very big, as we have all observed during these past three days, and I'm sure that the points that I am going to make at this time are not going to constitute a framework for an ideal solution.

By way of an introduction, I would like to note very briefly a fact that we are all aware of: namely, that research and development in this area that we have been exploring are just two legs of a stool, or rather two legs of a chair, because it appears to me that there are two more elements that should be included in an overall consideration of the problem. Once research and development have taken place, as we all know, they have to be followed by diffusion and implementation in turn. We are all familiar with the problems of marketing a new product. We will have, I assume, exactly the same problems in selling educational technology to the users, the teachers. We must make them aware of the existence of the new product, of its virtues and qualities, and we must help them integrate the new product into modes of behaviour which they may have developed over the past fifteen, twenty or twenty-five years, a condition which, as we all know, is not very conducive to rapid and enthusiastic change.

The conditions that appear to me to oppose fruitful educational research and development in the field of technology can be very roughly attributed to three main sources. It is always difficult to assign precise responsibilities in a given situation but it appears to me that the following analysis does not do too much injustice to any of the partners involved in this process.

Society as a whole, I feel, is responsible for the first obstacles to useful research in this field. First, we have to operate in a school system which is highly fragmented, in which authority is dispersed among a large number of persons or bodies. This makes it difficult, if not impossible, for a very large majority of them to undertake any substantial piece of research because of the very meager means at their disposal. Certainly no small school board, and possibly not even a very large one, can really undertake a carefully planned program of research in this field of technology because of the extremely large amount of money and human effort that will be required to carry it through. I am given to understand, for instance, that some of the research projects going on in the field of educational technology at this moment have been costed at somewhere around one-half million dollars.

Money is also basic to my second point. Educational research as a whole has not, in the past, been very generously endowed by the people who hand out the money to the educational authorities. We have in Canada a single example of a system for the performance of educational research which can be said to be impressive, both in terms of its size and in terms of the amounts of money it has at its disposal -- we all recognize OISE in that description. I am not in a position to assess the ultimate effectiveness of this organization, but it certainly appears, at the moment, to be the only organization in Canada that has the necessary human and financial resources to conduct research in a determined manner. The other attempts that have been made by other provinces are quite modest and, in my opinion, they are not likely to lead to very interesting research in a field that is so demanding as the one under consideration.

I will mention briefly, at this point, Mr. Chairman, a favorite theme of mine: I feel that society is very lacking in the sense that it seems not to be interested at all in attempting to discover how it is going to evolve in the next decades; nor in deriving from this probable evolution, conclusions regarding the way in which it should organize itself to face these conditions -- ones in which we, our children and our grandchildren will probably have to live. The Chairman of this morning's panel indicated to us that a recent issue of a certain periodical was partly, or entirely, devoted to "Forecasting the Future". This is the sort of thing I have in mind, if we give to the term "forecasting" a definition that might be a little bit more inclusive than has usually been the case. I am referring to attempts at forecasting the future in a way which would take into account, not only trends observable in past events, but also the probability of completely new events occuring which would orient society in a way which cannot be foreseen on the basis of past statistics. You are aware, I am sure, of the existence of such organizations as the Hudson Institute in the U.S. from which forecasts have been emanating, some of them rather frightening. You may be familiar with the existence of similar or analogous organizations in Europe, particularly French-speaking Europe, where a deliberate effort is made to attempt to foresee what the future has in store for us in terms of probable future events, not only in terms of past observed events. The idea of "prospective" as it is called in France implies another element which I would like to mention very briefly. It is understood, not simply as a scientific effort to discover the future, but also as including the element of a choice between possible futures. This is, to my ways of thinking anyway, one of the great failings of our society today: we are being programmed most effectively by various agencies, some of them governmental, some of them financial, some of them industrial, programmed in such a way that our future is being decided for us without our being at all aware of what is lying in wait for us. The Hudson Institute, for instance, recently forecasted that by the Year 2000, sixty per cent of the American population won't have any work to do, and that, for the forty per cent for which there remains work, the work day and the work year will be very much shorter than they are today. Now this, I understand, is a forecast based on present trends and probable occurences. What is lacking, I feel, is a decision on our part as to whether this is what we want to have happen. If society does not deliberately attempt to steer the future into directions that are acceptable to us, according to our system of values, I am afraid that our future will be most definitely decided by agencies which make decisions without having a very clear idea of what the repercussions of those decisions will be in twenty and thirty years' time.

If I turn now to the obstacles to fruitful educational research that seem to me to originate in the educational world, I will have to mention first something which, to my mind at least, derives from what I have just said. We have been told this morning, and at other times of course, that when teachers are asked to describe what they do in schools and, more pointedly, what they will be doing in schools ten years from now, they are very reticent and, for all practical purposes, unable to give an answer that is clear enough to guide those conversant with the new technology in devising the type of instruments and the type of physical environment which would be required. Why that reticence? Why that hesitation on the part of educators to forecast their own needs? I feel that it is, partly at least, due to the fact that they do not know themselves what kind of future we are going to have, what kind of society our children are going to have to live in as adults. Consequently, they do not know quite well how they should educate these children, tomorrow's adults. This reticence probably appears as a most embarrassing and a most irritating feature to people who are involved in the conception and the construction of the new technology; they should realize that there is something positive in that reticence, in the sense that teachers realize that they cannot keep doing, for ever and ever, what they have been doing up to this point.

A second problem concerning educational research which originates in the educational world is the pretty irrational organization of educational research as we have known it up to this point. Educational research has been more or less a dilettante sort of operation; people indulge in it on the basis of personal interest, of money that happens to be available, of time that can be wrenched away from one's employer; and generally on very piecemeal basis. This is clearly not the way in which solutions will be found to the major problems which the educational world is facing. If such a lackadaisical attitude were to be evidenced on the part of those people who are doing research in the field of cancer, for instance, I think we would consider that the medical profession was not taking itself, or its clientele, very seriously. I think the very same criticism can be made of educational research as it has applied in most places up to this time.

Some of the difficulties in doing valuable research in the field of educational technology today also come from industry and they derive from the very nature of our economic organization. The rather fierce competition that exists between manufacturers of equipment; the secretiveness that is sometimes to be observed concerning -- not the products that are available today; indeed they can be very talkative about these -- but about the ones that are now on the planning board and that will be brought forth five years from now. The lack of standardization by various industrial firms, concerns some very simple things indeed. We heard this morning that there are eleven different languages being used in the field of CAI at this moment. There is apparently an absence of any willingness, that I've been able to observe in any case, to establish by common agreement, quality standards in the field of educational technology. All of these things, Mr. Chairman, remind me very much of the conditions that can be observed and are generally to be deplored today in the field of car manufacture, and I'm wondering when the Ralph Nader of the Educational Technology World will arise and bring to our attention forcefully enough the fact that competition and profit motives are not necessarily conducive to the most efficient development of educational technology.

What are the remedies to this solution? Some of the suggestions that I would like to make are so evident that I shall skip them, but others seem a little less evident, so I'm going to take a few minutes to talk about them. It appears to me that the first requirement is cooperative action, not only on the part of educators and manufacturers -- of this we are all agreed and our presence here today is proof enough that we are aware of that need -- but also about cooperative action on the part of various educational authorities. It appears to me that if we guard jealously our local autonomies to the extent that we refuse to engage in cooperative action, we are pretty sure of always remaining at a very low level of educational research in the field of educational technology.

Mr. Miedzinski: Mr. Chairman, ladies and gentlemen, I will of course try to avoid repeating the same things that you have already heard from other members of the panel. However, I would like to stress that, while I may not express the same opinions, it does not follow that I differ from them. In fact, I can definitely subscribe to practically everything that has been said and I would gladly do so. I would, however, like to add another point of view. The problem on which I would like to concentrate first of all is why, and to what extent, there should be research on educational innovation in industry. First, let me make an aside. It is, of course, openly accepted by everyone in industry that industry must make a profit in order to exist. This is often referred to as the "profit motive" and it is very often, I think, misinterpreted. The profit motive, which is equivalent to the instinct of self-preservation, should not be equated with a determination to maximize profit under any circumstances. Looking at the activities of any larger corporation, you can find that they have several divisions, some of which are more profitable than others. If a corporation was motivated by the sole objective of maximizing profit, it would close down the less profitable divisions and expand the more profitable ones. The reason why this is not done is because, while a net profit must be made, the maximization of it is not a paramount objective. In particular, there are long-term objectives in industry as a member of society. We live within a society and would perish with this society, so we must try to be good citizens.

Industry, as has been stressed before, has a general economic long-term motive to support education. As a consumer of the products of education, it depends on the state of education in the country. For this reason alone, if research is needed in industry to speed up the necessary innovation in education, industry is willing to participate in such research even if it happens to be less profitable than other possible activities.

What may be the reasons, then, for industrial research in this field? First of all, there is but a limited amount of time to introduce innovation in education. So long as changes in our way of life are introduced faster than innovation in education, we will be falling further and further behind. To preserve our society in the competitive international field, industry has to make a sufficient contribution to make sure that lack of industrial know-how will not stand in the way of innovation being introduced rapidly enough. Industry can never ensure that change will be introduced at the necessary rate, but we must play our part. Considering the amount of research that needs to be undertaken, and particularly research on the more complex technical aspects, this could not be carried out fast enough without using industrial resources. Furthermore, there are many developments occuring within industrial laboratories which are very pertinent to educational technology. Researchers outside industry cannot know enough of these developments to be able to incorporate them in their projects. However, those who do pertinent research in industry for other purposes can also take action to see whether some results can be used early to develop instructional products. This can save up to ten years in the concept-to-application cycle.

A further reason is that obviously there is and there must be a strong inter-action between the kind of equipment that is being developed and the way in which it will be used. What would happen if no research (which means experimentation) was done with industrial participation, if industry were to limit itself exclusively to manufacturing gadgets to order when everything has been decided? I don't think anybody outside industry can come down with a complete specification developed in isolation from industry and say, "here is exactly the product we want; this is what you should produce". But even if this were possible, there would still be the problem that we would have to modify such specifications in order to produce the equipment economically. After all, costs depend on methods of production, and just as one piece of equipment can be used in many different ways, so one education objective can be achieved through many technical solutions, some of which cost more, others less.

It's most unlikely that anyone not working in industry and not being familiar with production methods, could specify equipment that would be anywhere near the minimum cost. Therefore, modifications would have to be introduced even to the hypothetical "ideal specifications". But if we in industry did not know anything about the methodology of application of such devices, how could we know whether the modifications we might want to introduce in order to reduce costs would not, in fact, defeat the objectives? Would the equipment still perform what it was meant to perform? So there must be enough industrial involvement to create understanding and permit dialogue in development.

Dr. Joly stated rightly that fierce competition and secretiveness might not necessarily be a good way of carrying out effective research in educational technology. I agree with him -- this is obviously an obstacle. However, so long as industry has to undertake such research alone and entirely at its own risk, there is no way of avoiding a strong measure of competition and secrecy without which the costs could not be recovered. One way in which secrecy could be eliminated or reduced is by introducing more research carried out in industry on orders from the educational authorities or the government, just as is done in the defence field to a very large extent. In other words, the greater the extent to which a society will support such research, the better can this society direct it. And if you support and direct anything, then necessarily you must be aware of everything that is involved.

The next question is that of determining the kind of research that industry can undertake in this field particularly well; what kind of contribution it can make. There are of course many possibilities, but one thing I would like to point out, in spite of its being obvious, is the fact that so far, the big problem in the application of technology in education is the man-machine inter-action. Technology means bringing into education some kinds of machines that will have to be used by people. So man-machine inter-action is the crux of the problem from both the technological and the educational points of view. As it happens, the schools and other educational institutions are not machine-intensive industries, but industry has been machine-intensive for some time now, as much as, or more than, labor-intensive. Thus industry has had considerable experience in the problems of man-machine inter-action. This inter-action occurs in industry in a different context. No one would say that industrial solutions could be directly translated into educational situations, but there is a background of experience which, under the direction of educators, could be used to great advantage. Providing we cooperate, there is a wealth of past experience that the educators could capitalize on, in order to speed up the development of things they need.

The next problem is evaluation and testing. We must bear in mind this problem, particularly when we talk of man-machine inter-action. The effectiveness of this inter-action cannot be tested without testing a total system. One cannot test it purely in an industrial laboratory. Furthermore, when I talk of testing in a total system, I really mean a total system. Bringing something into a classroom doesn't make it a total system. For example, a device might be completely condemned because it turns out that the initial program which had to be supplied with it for testing (since it could not be used without a program) wasn't working well. However, the concept of a total system implies that programs be developed, changed and improved in the light of results. Therefore, unless we provide a sufficiently close approximation of totalness, the tests are without value. Obviously, industry alone cannot provide a total system (with the exception of industrial training situations). So we must have cooperation in the field of testing and evaluation in order to get sensible results. To have such cooperation(and in order to have greater acceptance of technology in schools, it has to be accepted in order to be used effectively, but as a previous speaker has stated this may be a considerable obstacle) one needs to have teacher involvement. Unfortunately a widespread involvement cannot be developed through major, complex projects of which there can be very few only affecting teachers in some select locations. I would like to make a suggestion here (at the risk of stepping outside the boundary of what an industrial representative should say) that it's a matter of creating an atmosphere in which teachers are involved in innovation and with something to do with it. Once they are involved in any way, and once they are exposed to innovation and participate in it creatively themselves, they will, I think, be more likely to accept even the particular innovations with which they had nothing to do. I would like to appeal to the educational authorities, particularly to the institutes for research in education and to similar bodies in Departments of Education, to see if they could develop as many as possible simple ways for trying out various innovations involving technological devices by teachers at schools. It could be suggested to teachers that they volunteer to try these innovations and report back, or try to effect some improvement or some detailed method of application and report on this. We must have multiple parallel approaches in order to find out which is the best way of using technology in education, whether it's a large and complex system or a simple tape machine. There must be many attempts or trials, some of which will be more successful than others.

If we could involve many teachers in this sort of activity, I think this would create an atmosphere of something happening, an atmosphere of progress, of being involved in educational innovation creatively. This could help us all tremendously. Conversely, individual teachers should not, in general, be left all alone to devise methods of trying technology out in connection with a local salesman of tape recorders. Some teachers can make great progress this way, but progress should be much faster under the leadership of experts in the institutes of research and Departments of Education.

To conclude, I'd like to support recognitition of the very deep need for greater coordination and centralization of the efforts in educational research and innovation on a national scale which has been expressed before. In particular, I'd like to point out the fact that the distribution of creative talent at universities or schools, as well as the distribution of technological and creative capability in industry, are not correlated with provincial boundaries. It may happen that in one particular province there are several professors or principals who are greatly interested in innovation in education, while another province may have very few. Those who are so interested may not have the necessary industrial support within their province. It follows that independent provincial plans are unlikely to use the national resources to the fullest extent. I do therefore appeal that support for research in education should not be based on who lives where, but be coordinated within a general interprovincial plan.

Dr. Neal: Dr. Hallworth would now like to comment on another aspect of research and research facilities.

Dr. Hallworth: I, like Mr. Miedzinski, find myself in agreement with much of what has been said by other members of this panel and hope I shall not repeat too much of what has already been said. However, I should like to emphasize again what some members of the panel have already stated, namely, the need for much more educational research than is being carried out at the moment, and also the need for more funds, and particularly more centralized funds, for this purpose. Some of you may already be aware that several years ago, in the U.K., less money was spent on educational research than was spent on research into glue. I gather there are some very good glues about these days. Whether there is an excellent indigenous glue in Canada, I am unaware. But I would like to point out that in the U.K. the situation regarding research funds has now changed radically, and one would hope that a comparable change will come about in Canada.

There are three points which I would like to make and the first concerns the shortage of competent research workers. There is a shortage of people who are able to help introduce and assess the effects of a new technology, particularly applications involving computers. During the last year or so, approximately twenty regional educational laboratories have been established in the U.S. It is now suggested by an investigating committee that this is far too many; that probably no more than five or six should have been established, not because there is a shortage of funds, but because there is a shortage of competent people; and that because too many have been established for the people available to staff them. There is simply too much competition for the services of these few people. During this summer, in connection with a UNESCO survey, I had occasion to make enquiry of all the faculties of Education in the U.K. concerning their work in computer applications. I discovered, and not entirely to my surprise because I suspected this was the case, that in no more than two faculties of Education in the whole of the U.K. were the students being given any training whatsoever in computer programming, and this only in a very rudimentary manner. I have no precise information regarding the situation in Canada but I wish to suggest, in terms as emphatic as possible, that it is one of the functions of the faculties of Education to train research workers, and particularly to train higher degree students in computer applications, as a matter of urgency.

I would suggest that faculties of Education should not concern themselves with hardware. Even university engineering departments find it not very profitable to try to build a university computer. It is a waste of time because industry can do the job better and more cheaply. It would seem to me that faculties of Education should obtain their hardware elsewhere, and in this connection I would heartily support what Mr. Miedzinski has already said. I would also feel that faculties should not try to develop systems software. This can be far too time-consuming, particularly with the limited amount of programming and research effort they have available at the moment. I speak advisedly because several years ago I became involved in the implementation of a list-processing computer language for an English computer. It took far more time than we had anticipated and the result was that we just could not do some of the other work we had intended. It is a mistake for educationists to get involved in such matters when there are so many other urgent things waiting for them to do. However, I do think that there should be members of faculties of Education who are competent in at least the higher level computer languages, and they should be teaching these to at least some, and perhaps to quite a few, of their students. I am referring to such languages as FORTRAN. It seems to me that this can commonly be taught in association with statistical courses. Some faculties of Education in Canada are already teaching it. Computer languages should also be taught in connection with non-numerical applications. This is an area which is very much neglected at the present time. I am referring to computer applications such as school scheduling, simulation (of counsellor behavior, for example), computer-assisted learning, information storage and retrieval, and analysis of natural language. It would seem to me, incidentally, that most prospective teachers should be introduced to the use of computers in some form or other. I do not mean that they should learn to program in FORTRAN; there are much simpler ways of having them use a computer than that.

My second point relates primarily to what Mr. Miedzinski referred to as cooperation between education and industry. In particular, I should like to ask for a development of facilities, for producing computer-assisted learning programs, of a kind which can be put into the hands of teachers or intending teachers. Teachers can be expected to use such facilities. When an adequate and usable tool is put into a person's hands the natural tendency is for him to begin using it. I would regard this as the most effective way of getting computer-assisted learning accepted in schools. It would also be, for students, an excellent training in the presentation of certain types of materials. In effect, we need suitable hardware (reasonably-priced terminals and communications equipment) which is not at present available. I think perhaps one should point out that there probably is no more than one CAI terminal installed at this moment in a Canadian school or university, and possibly that one is not yet operational. So we are talking, in terms of the next few years, not of a situation in which we can do everything, but of a situation in which we must work hard to do anything.

I think perhaps we have been somewhat up in the air in our discussions; we have failed to appreciate that we have to get down to brass tacks before we will be in a pushbutton educational age. The tools are not yet available and usable; pushbuttons are a long way off. But we can reasonably ask industry for a low-cost terminal, and for efficient communications systems. We may also ask for a CAI language which can be put into the hands of teachers and which they can use immediately. There is no reason whatsoever why such a language should not be evolved. Indeed, it would seem that the one being developed by Mr. Brown and Mr. Brahan is probably of this kind.

My final point relates to the use of computer-assisted learning. I should like to make a plea that, as it comes into existence, we should use it as a technique for machine-aided cognition. In other words, I ask that we should always think of a computer as a means of extending a person's cognitive abilities -- if you like, as a means of helping a person to develop his intelligence. I use the word "intelligence" quite advisedly because I believe it is quite practicable to raise the level of national intelligence. Most of us probably accept the hypothesis that the introduction of any new symbolic tool has led to a higher level of intellectual performance. By a symbolic tool I mean, for example, natural language. An instance of a new symbolic tool would be the introduction of Arabic numerals to replace Roman numerals. Arabic numerals enabled us to teach multiplication and division to little children, instead of keeping these as university subjects as in the Middle Ages. I would also include, among symbolic tools, such simple devices as square root facility on a desk calculator. If I am teaching students to obtain a standard deviation, I don't want them to spend a lot of time getting square roots: I want them to be able to assume that they can get it without any trouble whatsoever and I want them to concentrate their attention on the standard deviation. I hope that we shall use computers for this kind of purpose, so that the machine performs lower-level cognitive operations while the human being concentrates on higher-level operations. And the man-machine inter-action should be progressive. While a student learns to compute a standard deviation he should have available a "square root program". After he can compute a standard deviation he should then have available a "standard deviation program" to use as a lower-level operation while he learns to compute, for example, a correlation coefficient.

Such a progression can already be arranged without any difficulty in some subject areas. Certain new computer languages are coming into use, such as APL (already available in two universities in this country) which have particular advantages in this respect. It appears that they may introduce an entirely new dimension of thinking in that it will be possible, for example, for the student to develop his own programs for the performing of matrix operations, and will refer to them by means of one symbol in the way in which, using a desk calculator, he can refer to a square root "program" by just pressing one key. This will enable him to learn to use matrix operations, to find out in practice how they work in a manner never before possible.

Other programs will make it quite practicable, using computer-assisted instruction equipment, to have a student work on an equation while the graph of this equation appears on a screen at his side, so that he can see the two simultaneously, and observe the graph change as he manipulates the equation. Hopefully, the effect will be that he will relate the two much more immediately than he would if he had to plot that graph with infinite care and with little ability to draw a straight line.

Computer-aided cognition, however, is not necessarily confined to mathematical and scientific subjects. One could equally well apply it in Social Studies to produce, for example, more quickly and more comprehensively, a concept of a certain geographical or world region. There is no reason, ultimately, why one shouldn't be able to have a cathode ray screen with a light pen and provide the facility for a student to add to or take away lines from a drawing appearing on the screen. There are already programs in existence which will rotate vertically or horizontally a three-dimensional drawing. The first such program, the "Sketch-Pad", was developed by Sutherland at M.I.T. some four or five years ago. Programs like this could enable an engineer to draw a bridge, turn it round, and look at the other side of what he has drawn; and there is no reason why he should not be able to test strengths of various materials by putting various loads onto the bridge to see just how and where it breaks.

This is, I hope, how we shall use computer-assisted learning as a means of extending and developing a student's cognitive abilities. And I use the word "learning" rather than "instruction" because I should like to emphasize that our interest should be, essentially, in developing intelligence.

Dr. Neal: Well, I'm sorry that we didn't provide you with the opportunity to get into the act, and I might point out that one of our difficulties was that the starting time was twenty minutes late. I guess we were all responsible for that. I think there's need for a final word though -- it's quite evident that some themes have come through from the panel. It does strike me that when we look at the paucity of resources we've had for research, given to us by society in the past, we're extremely lucky that our schools are as good as they are. But they're not good enough, and they won't become better as rapidly as we want, nor as good as they will have to be, unless we can get into the area of research and development with much more common sense, much more coordination and much more resources. On your behalf I would like to thank the panel for their contributions.

APPENDIX I

EDUCATION AND THE NEW TECHNOLOGY - SOME BACKGROUND MATERIAL

by
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We are in the midst of an education revolution. Some advances or changes are being effected with little fanfare or publicity, and others are meeting resistance in attempts to take over. Most everyone, teachers, parents, businessmen and industrialists, want to have education changed and improved. To date, no one has produced an acceptable blueprint for us to follow; yet we must decide on the direction and determine our path or be swept along with the tide.

If there is any assumption behind these notes, it is that educators can make the best decisions as to what should be taught in the schools and should guard this right. They can maintain this position only if they provide the best education possible for their charges. In doing this they must convince members of the legislatures that they know what they are doing, enlighten the general public, and consider both what business and industry want and have to offer. The public provides the final answer at any one point; educators have a responsibility to see that that answer is the best possible. How many educators are consciously attempting this?

The notes which follow have neither special truth nor value claims. They are bits and pieces selected at random, or reactions to what is being published. They are offered to stimulate thought, not to mold it. You may agree or disagree with any or all of them with impunity -- however, I would be disturbed if you either agreed or disagreed with all of them.

In matters concerning education, the education, business and government communities have been slow in pursuing creative cooperation with a view to educating one another. That is what this symposium is all about -- for us to discover better ways of enlightening one another for mutual benefits. The extent to which we can improve our insights and procedures will determine the sort of education structure we hand over to the next generation.

Aims of the Symposium

To attempt to assess the impact of technology on the schools, the pupils and the teachers to date, and to make astute guesses as to the future and the speed of change.

To consider how guidelines might be prepared which teachers and administrators might adopt while taking full advantage of the coming age of technology in the field of education.

To consider the feasibility of developing productive working relationships among top-ranking members of the academic world, government officials, and executives from business and industry. To determine a framework for the undertaking of research projects in school, university, factory and elsewhere. Possibly to enlist a task force which would attack the problems related to automated education within the next decade and make this information available to all concerned.

To outline certain requirements for a theory of education that has value claims for adoption, if we are going to make full use of modern technology both for the good of the individual and of society.

To consider how to develop, improve and implement a technology of instruction, learning and training. To look at innovations and change from the practical consideration of costs, results and increased efficiency.

To provide a forum for many who have been thinking and dreaming about schools for tomorrow, and who wish to have some influence in shaping the education system.

To communicate something of the thinking of those who attend the symposium through making papers available to a wider audience and preparing a report on the meeting.

To bring together some of those who develop "hardware", those responsible for the "software" and those responsible for deciding what the schools will do and how they will go about it.

Some Quotations and Comments on Automation and Education

Much of education now trains and develops man for a system based on mass production -- essentially an economic man. If automation means more leisure then it is a wonderful yet frightening challenge for education, and education must prepare man for leisure as well as for work.

Will we be faced with a tyranny of technology by those who understand and control the new technology? Is "better" education the way to offset this?

Many of our older generations have little knowledge of what today's computers can dc -- of physicians using computers in making diagnosis; scholars using computers to collate manuscripts, prepare bibliographies or review the literature; businessmen using computers for perpetual inventory or decision-making, etc. How many of our youth are let in on the technologies of computers?

"Because automation is a revolutionary break-through in machine and communication technology, the response of education to automation must be revolutionary". (Timothy Reid, York)

"Those who think automation means changing a few manufacturing industries don't realize that it will affect everything... We are today only seeing the tip of the iceberg... When machines begin to have voices and begin to talk to each other that isn't just a mere technological change". (John Diebold, coiner of the word 'automation')

"When television came along, educators saw it as a threat rather than as a potent new environmental fact. The reason was simply that the re-importation of ambiguity to experience, which television brought with it, contradicted the academic sense of order that the bias of print had been busy establishing for five hundred years". (M.E. Lafountaine)

"We want the computer to do more than just improve the educational process. We visualize a situation where the computer actually becomes an extension of man's mind. If man, with his creativity, could freely communicate with the computer, profound changes might take place in our civilization. By exposing the child to it from the start, so that he turns to it naturally for the solution of his problems, we may reach that stage". (L.A. Muller, I.B.M.)

"The greatest single barrier standing in the way of individualizing instruction is that teachers have been educated to teach groups rather than individuals". (Dr. Stan Heather, New York)

"In the age of the computer, the role of the teacher remains to be defined. What seems inescapable, however, is that a complete re-education of teachers and school administrators will be necessary to enable them to cope with the evaluation and selection of computer impact material". (IDEA)

Educational technology, according to R. Louis Bright, U.S.O.E., is based on two fundamental principles. First, the objectives of any educational system should be designed to bring about behavioral changes in the students, making them better able to cope with life situations. To do this, you set objectives in terms of behavior, then provide all the necessary steps to reach the final goal. Second, you assume the program is inadequate and change it if it does not modify the student's behavior. Educational technology is not synonymous with hardware or software and may or may not use such.

Expo provided a showcase for new audio-visual techniques, some of them bordering on psychedelic experiences. Crowd reaction contributed to some idea of the acceptance of these. Is there anything of value for education in the techniques or forms used?

Some General Questions and Consideration

The Symposium, of necessity, will be concerned with:

1. A pragmatic philosophy of education which considers values, role of education in society, needs of students, behavior of objectives, the learning process and "learning lanes" covering reactions from physiological gradients to productive thinking, and provides for the incorporation of newer media with tried methods.

2. Automated education, including simulated learning situations, information storage and retrieval.

3. Programmed instruction, linear and branching, related or separate from the computer, feedback for evaluation program and pupil progress, etc.

4. Use of the systems approach in education. New emphasis on standards, measurements and evaluations.

5. The emergence of big business in education, and mergers to make this effective.

6. A new look at teacher education and training.

7. The use of the overhead projector, T.V., radio, telephone and speaker phones, and other newer media such as CAI, the electronic blackboard, talking typewriter, etc.

8. Contributions of technology to counselling.

9. The systems approach.

10. What do we mean by newer media, automated education, educational technology and such?

11. Will the introduction of the newer media result in more, or less, total involvement of the learner? What do we mean by "total experience"?

12. Can the newer media contribute to activism, discovery learning, team teaching, independent study, etc.?

13. Is it fair to describe the product of the schools as "battered by 12 to 13 years of demanding instruction and Procrustean final examinations"? When we graduate youth, what are we proclaiming? That they met a minimum standard or better in knowledge of specific curricular materials or that they have reached various levels of understanding of the arts and the humanities; mathematical competence; the social and natural sciences; appreciation of visual arts, music, literature, and have received instruction in health and physical education?

14. Schools, along with thehome and church, share responsibility for the inculcation and development of ideals and values, social and civic participation and vocational competence. Can the newer media contribute to this and how?

TECHNOLOGY AND INDIVIDUAL DIFFERENCES

Psychologists have been concerned with individual differences for the past half-century -- heredity versus environment, nature versus nurture, the number of variables and their organization, general versus specific abilities, etc. There is not too much agreement in theory, but no question about there being differences.

In what ways and for what reasons do youth differ? Certainly they differ in speed of learning, depth of perception, ways of learning, experiential and social background, intellectual development. How great are these differences? Can and should we provide for these, and more, in instruction? Should schools aim to reduce these differences, or by developing youth according to capacity, to increase them? Background, present attainment and aptitude are important considerations in helping the disadvantaged. What should we be doing for the bright?

The argument continues as to whether the differences are essentially due to heredity or environment. The advantage, all things considered, seems to be with those who consider differences due to a combination of both, but varying degree from youth to youth, an integrative approach.

The concept of individual differences has received lip worship for fifty years; why hasn't it affected our schools to a greater extent?

Are there sex differences? Or are differences found in testing artifacts of the tests used? Girls generally do much better on teacher-made tests and some better on achievement tests. Boys tend to get higher marks in science, girls in language. More boys seem to excel at upper levels of scholastic achievement by the end of secondary school. Are such differences as are found artifacts of the tests used?

Girls are, on the average, taller than boys through ages 11 to 13 and heavier than boys from ages 10 to 14. Boys are superior to girls in the dashes, running broad-jump and throwing. These are easy to measure, but not as pertinent as some other characteristics for schooling.

The term "individual differences" for some is associated with efforts to provide special programs and assistance for those who cannot benefit from regular instruction, including the exceptionally bright, dull or handicapped. Handicaps could be due to physical, mental or emotional damage or other impairment, or weakness, upbringing in disadvantaged homes or areas, immigrant and transient populations, etc. Whether a development program, or only adjustment of school curricula, is in order is a moot question. What can the new technologies contribute to this?

From a psychiatric point of view most behavior is not entirely rational but reflects the "Games People Play". An intelligence test will tell you nothing about an individual's needs for acceptance, approval, attention and such. Can the newer techniques provide for such needs, avoid rubbing people the wrong way, and curtail somewhat the development of manias, phobias, etc.? We cannot settle the question of using the newer media without considerations of mental hygiene.

The grade system generally moves pupils ahead chronologically, though modified somewhat by accomplishment. It has a tendency to disregard the facts of human variability. Promotion from grade to grade on the basis of rigid standards is feasible administratively, but not psychologically. Yearly promotions, repetition of grades, classes of 20 to 30 under one teacher are administratively easy but psychologically unsound.

Homogeneous grouping assumes that traits and abilities are highly correlated within the individual -- a position not supported by experimental evidence. Intra-individual trait differences cannot be ignored.

Highly effective teaching helps to reduce somewhat difficulties associated with individual differences. Can the computer and other aids help in this? In any Grade VIII class one expects to find some students with reading or mathematical ability of Grade IV level, some with Grade XII level and the majority with Grade VII to IX ability as determined by achievement tests. Homogeneous grouping reduces such heterogeneity somewhat but not for all subject matter.

Some schools in Britain concentrate on scholarship material. Some fraternities see that all their members pass. Some students, like football players, are graded by size and move up to fit the desks. Are we trying to have all students reach a certain minimal acceptable level, have a few gifted ones really excel, a combination of these, or have we really decided what we are trying to do?

There is today no good reason for having high school youth leave school without some acquaintance with economics, sociology, psychology and anthropology, to select four areas concerned with people and society and of use in day-to-day living. Certainly they are not beyond the student's ability nor his out-of-school vicarious experience. Could this be used to increase interest for some pupils and to meet demands of individual differences?

Many of today's beginners enter school having absorbed 3000-4000 hours of television, radio, movies, the telephone, and hi-fi, an important dynamic sector of our environment -- intake from them gives youngsters a vast reservoir of vicarious experiences and loosely related facts to be sorted out. Do we take advantage of this in school or shut it out?

Is the school environment -- systematic, one thing at a time, orderly and linear -- too great a break with youth who are used to communicating through image and sound in a spaceless age and global village. Does the school tend to kill interests and stifle imagination?

Conditioning and habit-formation has always played an important part in education. Linear programming is an additional tool with possibilities to condition and habituate responses and discourage discovery learning and creativity. It ignores all individual differences except speed of learning.

Equalization of educational opportunity need not mean treating everyone the same. Today each student is required to read the same material, and within limits of a day or two each grade is required to reach the same point at the same time.

How can we overcome resistance to learning by some ethnic groups, by many underprivileged, etc.?

We do not have any really clear-cut scientific idea of the extent to which instruction can be individualized -- certainly not on a deep conceptualized basis.

Assessment tests as used at present are blunt and insensitive -- a typical complaint is "if our instruments tested more than limited cognitive results of learning .....". Is there a danger that too much testing could stifle initiative?

Will automated education be harnessed to provide custom-tailored multi-media, computer-assisted instruction on an individualized basis?

The principal obstacles to computer-assisted instruction are not technological but pedagogical. How can we devise ways of individualizing instruction and of designing curricula that are suited to individuals rather than groups?

Computers can keep good and minute records. They could easily submerge us in paper. How do you select the small amount of material you want the computer to retain?

The computer is used in research to provide statistical analysis including factor analysis, co-variance, etc., linear programming, simulated games, and the analysis of subject matter. Education researchers have often been accused of using powerful techniques to solve minutae. Should they use computers for the same purposes, more criticism can be expected. Study of appropriate uses of the computer to solve important problems must receive some priority. Under-utilization of a computer presents problems.

Should we use a centralized or decentralized, or mixed computer system for a region? What are the advantages and disadvantages of each? There are some 1000 computer programming languages. Which should be used and where? What is the cost effectiveness of each system?

Computer learning programs often emphasize some one type of logic, inductive or deductive and select one length of step and pacing rate. There is room for considerable research here.

There is need for study of resistance to change and innovation. Should we attack these relevant problems? What are the chances of receiving adequate support for computer innovation in education?

Is the new audio-visual movement bent on turning out non-readers? Is it designed to coddle the weak intellect and hold the bright student back? Will it make the student only an IBM card? Will electronic instruction make intellectual capons of students?

Will the new libraries have students lose the rewards of serendipity and browsing? Will the non-book materials and documentary information together with automated cataloguing services serve to reduce individual differences?

The learner must start from where he is and go ahead at a speed determined by his ability to progress. Learning takes place at one or other of the many growing edges which individuals possess at any one time. Learning is developmental and the growth can be stimulated and facilitated or slowed down even to result in frustration. Neither conditioning nor cognition can produce a well-educated man. Learning is multi-dimensional and the schools must provide training, guidance, or variety of learning situations and stimulation.

Do "individual study", "team teaching" and "computer-assisted instruction" disturb the comfortable role of the teacher? Will some feel frustrated, unwanted and neglected if pupils move to take over instruction?

Are the usual texts plus lessons the best way to teach geography?

Can Shakespeare be taught best using a cognitive, verbal approach or would it be better to use films,etc.?

What can teachers do better than can be done by modern media?

Are text books subject to restrictive influences of publishers, authors, book buyers, professional faculties and the dead hand of the past? Would pupils, proceeding at their own pace, and selecting alternative objectives and methods from a wealth of materials, be too disturbing to school organization?

Have we considered the newer media from the viewpoint of mental hygiene? Will there be fewer or more instances of frustration, phobias, manias, etc.? Assuming that many children have these when they enter school, can machines help?

THEORY OF EDUCATION AND TECHNOLOGY

Quality education means many things to many people. To some it means raising standards which may result from either raising the floor for acceptance or bringing up the average level of accomplishment. It may be related to the systems approach, with goals set and ways of reaching the goals undergoing refinement to increase efficiency. Certainly this can increase quality control, save time and increase efficiency. Or it may emphasize testing, diagnosis, and the providing of individual programs with emphasis on achievement in the individual's strengths. Or again it may be related to values with priority given to discovery learning, to creativity and to productive thinking. What does it mean to you?

Quality may be interpreted in terms of uniformity of product and standardization of process comparable to production on a belt line; or it may put emphasis on creativity and improvement. What are our standards for excellence? Evaluation to date has been based largely on opinion of teachers, satisfaction of parents, and experiments comparing method A with method B for a limited time with tests emphasizing information content. Recently it has become popular to add student opinion; and there are a few longitudinal studies with a limited number of variables. Most of our questions remain unanswered.

Educational Objectives

There appears to be a high correlation between educational objectives and the efficiency of the procedures with which they are to be carried out. Inefficient learning tends to be associated with "broad" unclear objectives. Where objectives are stated with a behavioral precision, efficiency of learning is higher.

Education should be designed so that children will have a happy childhood and a good start in life. It should provide a full measure of educational opportunity for youth, with experiences aimed at stimulating each to develop his various talents, thus enriching his country's industrial development and culture.

What does individualizing instruction mean? To some it means providing three streams which operate at different speeds but which are expected to end up at the same goals, at the end of the school year. To others it means providing three streams -- one headed towards university, the second to post-secondary education and the third towards apprenticeship, skilled trades and service occupations. Does it provide for a core curriculum and some options or does it go all the way, with students determining what they will study and how fast they will go?

In education we have always had proponents of the "one answer to our problems" -- the Dalton, Winnetka, Morrison methodology, various streaming plans, socialized recitation, programmed instruction by teaching machine, and the computer are examples. Do we have to settle for one method?

A study of the rise and fall, or institutionalization of innovations is an interesting preoccupation. Today we do not know why some catch on while others fail. One cannot conclude that it is a matter of merit, convenience, simplicity, general applicability, etc., although these may be factors in acceptance or refusal.

Some Questions

What are the marks of an educated man today?

Is it more important to have "done well" in school or to have acquired a thirst for knowledge? Are these compatible?

What elements of education can best be depersonalized?

What elements of education can best be carried on within a school, or outside the school?

For what elements of education is a teacher essential, desirable, superfluous?

Using modern media, we can teach reading to children aged two to four, calculus to Grades II and III, symbolic logic to ten-year-olds, etc. Is this the best use to make of the teachers' and pupils' time? Is the best time to teach materials when they can, and will, be used?

Is there any advantage or disadvantage in transferring kindergarten and Grade I subject matter to an earlier age?

Interminable debate over objectives appears to be a cherished activity of every profession. Why should education in particular be so closely associated with aims? Is this because we know less about what we are trying to do than do workers in other areas? Or is it because the education process is highly diffuse and difficult, or that it is to some extent concerned with morals, religion and politics?

Can our purpose be described as that of providing vastly increased education and training for all members of society, individualized attention to permit each student to reach his potential and to utilize human resources most fully, and efforts directed towards increasing the productivity and efficiency in the teaching and learning process? Must we convert these general purposes into specific ones, and should these be in behavioral terms?

Is education today hopeful of preparing today's youth for the unpredictable world of tomorrow? Is much of education in reality still preparing youth for the more slow-moving stereotyped world of yesteryear? How many of us, parents and teachers alike, are children of yesterday lost in today's world?

Yesterday it was often adequate for a worker to be "willing to learn" and "willing to do anything". Today most employers demand expertise in some area and the background for, and capacity to learn, new skills and concepts at a reasonably high level of comprehension. At what school level will one pass from functional illiteracy relevant to demands of employers tomorrow?

Do our teaching methods and the subject matter employed correspond to the technological demands of the students' world?

Is it most important for education to be aimed at equipping the individual with the attitude of mind, capability, the tools and a desire to continue his personal and professional growth as long as he lives? Which of the things we are doing at present help with this and what ones mitigate against it?

The educator's goal has always been the individualization of student progress according to his background, aptitude and achievement. Will the newer media help with this? How far will this inevitably disrupt current administrative procedural methodology. Are there good reasons for retaining a five-day week, 200-day year, nine-to-four organization with curriculum, promotion, and in fact administration fitted to this?

Will the new technology be directed towards (1) reaching larger groups with fewer teachers, yet providing quality; or (2) individualizing instruction and freeing students of pace and time limitations?

Will the new devices close the feedback gap between student and teacher?

Can we maintain the level of curiosity and willingness to participate of the primary grades throughout the elementary-secondary years?

Is the division of schools into levels an obsolete practice? Would it be better to have all schools in a complex or on one campus -- an education shopping centre?

Can the modern media be used to assist all teachers develop a personal theory of education as a part of in-service training? Can it help to keep teachers up-do-date through up-grading?

What are the contributions of the following to education theory and practice: psychology (developmental, differential), sociology, economics, anthropology, engineering, communication theory, etc.? Can a theory provide the structure necessary to hold all contending elements with validity claims together?

INSTRUCTION FOR TOMORROW

In post-pioneer days most schools had a few books, quill pens, slates, a bell, a strap or canes, and a register; and some, in addition, had a globe, a few maps, an abacus and some little materials for busy work. In 1967 the Canadian Education Showplace featured over 900 booths (some companies used several) with thousands of different articles for school use being exhibited. Nevertheless, the education industry differs from other industries in the small percentage spent for equipment compared with the amount spent on the building, and the relatively high costs of manpower.

The population explosion has become population increase except for entrance to post-secondary classes and to university. Teacher shortage at the elementary-secondary levels is not so much a lack of living bodies adequate as custodians, as lack of highly qualified specialists and other professionals. Demands of society and industry are increasing and the pressures will increase even though industry accepts greater responsibility for on-the-job training.

The impact of today's student on the new technology is likely to be greater than the impact of the technology on the student.

Each student, whether living in the country or in the city, can have a personal tutor as knowledgeable as a modern Aristotle.

Formerly, undergraduates in engineering used to carry a slide rule as a symbol of competence -- today they would have to carry a computer -- perhaps tomorrow computers will be portable.

We are aiming to overcome uneven instruction, provide for various ways of learning, give broader background materials; and ensure richer experiences -- auditory, visual, emotional, cognitive, verbal, etc. -- this could ensure total involvement.

Do team teaching, flexible group organization, and the non-graded school make it easier to utilize the newer media?

Can team teaching contribute to providing individualized instruction?

Would it be more efficient to provide busy work, drill exercises and such in quantity?

In pioneer days, pupils learned their lessons and recited them to the teacher. Later teachers prepared lessons and recited to pupils. Now teachers can push a button and everyone can listen to a lecture. If teachers must interpret texts to pupils (assuming this is the purpose of the recitation), is the text deficient? Can busy work be prepared best as "pot-boilers" by teachers or should it be prepared in quantity, with the teacher selecting what is appropriate?

Are teachers the best persons to operate or conduct language laboratories, television lessons, computer-assisted programs and such? If not, what is the answer?

A good teacher may: provide the occasional inspiring lecture; occasionally open new vistas; tutor students and help to resolve learning problems; make use of the institutional benefits of group instruction; and adapt curricular materials to pupils' needs.

A teacher can set a high intellectual example. He can inspire students to higher order functions, encourage creativity and provide counsel, motivating and stimulating youth to greater effort.

One function of school is to help youth adjust to its environment. Much of this is done through informal education -- the school can best begin where other forces leave off, and we have a lifetime for this.

It is easier for a teacher to learn the essentials of technology so as to fully exploit the new media machines than for a competent technologist to become a good teacher.

Many experts today consider that all objectives should be expressed in behavioral terms.

We still want a warm, living body as the central figure in the classroom; teacher-pupil relationships provide the background for using the new media.

"Education business" provides for commerce in hardware and software, including the collecting, compiling, organizing or generating of information and selling it, generally to research firms or personnel, government or libraries.

It provides for inventing, manufacturing and marketing systems of instruction ranging from textbooks to computer-assisted instruction. It also provides for the communication of information and organized courses, though often mixed with entertainment. In addition, it provides a market for services and products from consulting firms, texts, systems management and such. The big problem is to determine the applications for which technologies and services should be used in specific situations.

Much advertising is biased and misleading. Schools therefore must provide consumer education which enables students to look critically and intelligently at what is known as the "Madison Avenue Morality". David Gast in the Phi Delta Kappan notes: "Madison Avenue techniques have wrought profound changes in American value orientation, and it's up to educators to supply a counterforce". Can modern media help in this?

Is it efficient to prepare lessons and lectures to be delivered once (or rewarmed once a year)? Some teachers have developed a comfortable routine of preparing work and reciting it to the class, reviewing, testing and assigning homework. Some professors read essays, for students to take notes. Could this mean that the texts are inadequate or that the lectures should be put on tape?

Competence is not a unitary quality -- teachers can be competent in teaching reading and incompetent in teaching number work, but may be required to teach both. Team teaching and modern media can ensure that more pupils get good instruction. Some pupils may have to have "incompetent" teachers but none need have incompetent lessons.

A teacher may spend one-third or more of her time in non-instructional functions and activities, as clerk, hostess, librarian, counsellor, ticket seller, housekeeper, messenger boy, data processor, marker and examiner, policeman, decorator, and busy work and drill preparer and assembler of materials.

Teachers have many responsibilities. These vary considerably for both level and situation. They include custodial, information imparting, stimulation of interest, conducting discussion, evaluation of progress, etc. Do we make the best use of the time of competent professional teachers if they perform many of these tasks? Can electronic and other aids relieve them of much routine work? Are team teaching and teacher's aids part of the answer?

Computer-Assisted Instruction

Computers can be programmed to give students modular tests covering skills pertinent to various courses to discover their strengths and weaknesses -- then a terminal can provide make-up, crash materials. Will this meet individual needs adequately?

The computer has so far: (i) found proof for problems in symbolic logic; (ii) played checkers; (iii) memorized by rote; (iv) solved mathematics problems (v) formed concepts; (vi) translated languages; and (vii) made a start at developing general theories. Computers are developing powerful strategies if harnessed, and can no longer be considered merely as a handy means of getting boring, repetitive work done.

The computer can provide simulated programs -- for example, the computer can let the Chemistry student explore theoretical paths leading to an explosion or bad results, then start over without risk or damage and with a saving of time.

Computers are now capable of solving mathematics and science problems. They are useful in accounting, record keeping and logistic control. By using time-sharing with one-line teletypes and CRT display equipment to support educational endeavour they can assist with a wide range of intellectual processes. Inquiry stations have been used in teaching mathematics; significant developments have been made in the use of simulation techniques, natural language processing programs, information utility and data books, compiling systems, information storage and retrieval, etc. "It is usually difficult to think of worthwhile things for a computer to do that cannot be done more simply and economically with an intrinsically programmed device." Is this a stage in development, an exaggeration or what?

Learning how to write and revise linear programs is good training for teachers. It develops skills in response analysis, program testing, program revision, and the analysis of subject matter into behavior units.

We have all heard that a computer never loses its temper, nor does it change from day to day or have "pets"; that it never pats a child on the head, laughs with him or kids him along. One might ask whether it can provide motivation for sustained periods, whether it sometimes causes frustration, and about the number of dropouts there would be if computers were used for much instruction.

Will the sociological jungle of man-machine relationship create more problems than it solves?

Time can be shared on the computer among terminals which may include (i) a visual device such as cathode ray tube (television screen), (ii) a typewriter keyboard, (iii) a light pen, (iv) appropriate sound devices, (v) motion pictures and line drawings. It can provide for instruction, such as (i) drill and practice systems, (ii) a tutorial system and (iii) a dialogue system. The latter is most difficult, especially if you expect the computer to recognize speech. There is need for considerably more research related to the development of fundamental theory about learning and retention.

The computer can keep good records but these must be interpreted creatively and individually.

Students have different cognitive styles and learning patterns. How do you prepare programs for these?

Drill, practice and diagnostic programs can be keyed to a computer program.

Learning or Language Laboratories

These are not limited to the study of foreign languages. They can have up to 100 or more booths and accomodate up to 2000 people. They can provide a variety of learning experiences -- from passive listening to a teacher, record, tape, etc., to audio-active with immediate "hearback" available, to dialogue between instructor and class, and review where lessons can be reproduced from a tape recorder using a second tape where expedient.

The laboratories can be combined with a computer or used otherwise.

Programmed Instruction -- Why Haven't the Promises Made for Programmed Instruction Been Fulfilled?

Were too many promises made? "We no longer need school buildings or teachers -- all we need are programmed materials and playgrounds."

The programmed process pointed the way to an entirely new procedure for developing instructions, providing feedback evaluation and providing an interlocking instructional system with the instructor and instructed systematically shaping each other's behavior. The record of the learner's reactions can serve in revising the old program. Each student teacher and program writer can receive immediate individual feedback.

How many pieces of language laboratory equipment and teaching machines are now stored in basements because teachers have no language programs or other software and would not know how to use them if they did? Selling hardware where there is little or no suitable software has encouraged hostility among educators.

Training materials for vocational education can be developed using task and skill analysis, management and administrative techniques. Are there better methods?

The use of programmed instruction has never been exploited -- perhaps not understood -- in business and industry. Programmed instruction can be carried on in the shops with experienced resource people available when needed. The programs can be real and realistic, and adapted to time, need and expediency. The motivation is largely economic, though often social as well. On-the-shelf programs are handy and can readily be fitted into the work schedule.

New Developments -- e.g. EVR

While much thought and experimentation will be directed towards simplifying and lowering the cost of hardware already on the market, other efforts will be directed towards producing new machines and devices, particularly for electronic reproduction, capable of bringing the printed and spoken word, pictures and film into schools, living rooms and factories at a cost which everyone can afford.

The new CBS invention, EVR (Electronic Video Recording and Reproduction) will provide cassettes which use filmed lectures, reading materials or stills at an expected cost of around $225 for the box and $100 for the materials. Materials for the cassettes can come from television programs, education films or specially prepared new materials. Ease of handling and storage is suggested since "the entire corpus of the Encyclopedia Britannica can be put on one and a half cassettes measuring seven inches in diameter, and giving the viewer a reproduction which is considerably greater than anything that microfilm can offer, at a cost which is one-fourteenth of the volumes concerned".

EVR has several advantages over ETV, except for direct viewing of current events while they are happening. The programs can be shown most anywhere, at desired times, as often as desired; interrupted at any point, and selected from whatever is available. The film cartridges and players seem to have application for education systems and computerized information retrieval.

At about the same time Borg-Warner has developed a new audio-visual educational system to be sold to schools for under $400 which consists of an electronic unit resembling a small television set, a color film slide and a record synchronized with the slide. The student selects his response using five buttons, and branching features are provided for wrong responses. The student sets his own pace.

Some companies are concentrating on developing programs and other software. By the time a current list is prepared, it is out of date, yet the quantity of software is wholly inadequate.

Some Questions Related to Instruction

When we speak of newer media, automated education and such, what are we talking about?

Do the newer media bring academic and vocational education closer together?

How much of one's anatomy is used in learning academic subjects in school? Is this adequate?

Have we gone too far in using a cognitive approach to learning?

Are the new programs generally unimaginative, over-prompted, under-tested and redundant?

Are there conflicts between some of the newer approaches, individualized study, self-directed study, team teaching, discovery approach, quality education, computer-assisted programs, programmed instruction, spiral approach, etc.?

Can we combine pupil-centered and curricula-centered approaches?

What is the best way to discover the optimum use of new gadgetry in education? For example, what uses of the overhead projector can be recommended and what ones discouraged?

PRACTICAL CONSIDERATIONS OF THE NEW TECHNOLOGY AND EDUCATION

The education systems -- we normally speak of a provincial education system as if it were a well-organized, tightly-knit unit organized to produce "educated" persons. Actually it is a loosely-knit agglomeration of fairly distinct units at several levels, with some gaps and with overlapping, with lines of authority, and where adjustments are generally made piecemeal with little consideration of the possible overall effect on the whole.

Do we favour a systematic organization of education? If we do, then we must consider input, the process, and output for each of the units in the system, and the relationships among the components since changes in one can affect the others, but particularly from the bottom up. Planning is essential as is research and development with assessment and evaluation throughout.

The history of education is an account of one crisis after another with the current crisis probably more demanding of change than any other at any strategic point to date. We all recognize the population and knowledge explosions, but the technological revolution with automation and the social changes and demands introduce new factors and reflect greater discrepancies between what is available and produced and demands than ever before.

Crises have generally reflected shortages of teachers, buildings, funds and materials at one or more levels; but they may also reflect school systems ever more out of touch with the needs of society and the individual than is generally acceptable. The education offered today would not only have been considered adequate, but exemplary, yesterday. It now appears to fall far short of meeting both social and economic demands as well as the demands of many individuals. More is expected of today's schools than ever before -- perhaps more than they can deliver.

One aspect of today's problems relates to automation and the new technology. The industrial and social community now demands higher levels of technical competence, greater acumen, perspicacity and insight and greater flexibility and ability to learn rapidly, than ever before. Youth lives in a new world coming closer to total involvement with it because of rapid strides in transportation and communication.

New technological advance in instruments, media and methods outside the school provides possibilities for changing schools from the craftsman stage to more modern production in a hurry.

The present crisis in education is not peculiar to Canada. It is world-wide, though varying from country to country in intensity, the factors demanding priority and the solutions needed. R and D have a place in restoring some degree of equilibrium.

At any one time there should be a well-defined education policy. But education policy should be a dynamic growing thing, adapting to embrace new facts, understandings and insights. In Canada each province, district and institution should spell out their education policy. There should be provision and structure for co-ordinating these and relating them to the Federal Government's educational endeavour.

Education policy should embrace all formal and informal education, that is, education from nursery school and kindergarten to post-graduate; from apprenticeship to engineering, special public and private, whether in or out of school. An appreciation of the contribution of mass media to our education is important.

Innovation is at a premium. Not change for the sake of change, but tested improvement is what is needed. Panic moves to meet crises will not result in balanced progress. Changes in education have generally been made under the assumption that if agreement can be reached by a representative committee, the proposed change should be adopted and will work. Industry generally assumes that no change will be 100 per cent effective -- that the "bugs" must be removed. New automobile models go from drafting board, to dummies, to proving grounds -- even then it is not unusual to call models in for changes after they are on the market or sold.

Innovations which would have been introduced with impunity some years ago, should today undergo field testing -- the situation has changed.

Needs in business, government and education institutions threaten to overwhelm existing education and training output. Do computers hold the key to a solution?

School administrators have the task of putting the new instruments and tools to use in the nation's classrooms.

Too many school administrators tend to think in terms of how the new media can help the teacher do her traditional job better. They prefer to emphasize stability rather than change. One cannot but recall that the "horseless carriage approach" is the usual way of introducing change. Eventually we will ask what the peculiar attributes of the new gadgetry are and how they can best contribute, not to the process as we know it, but to achieve the ends we desire.

Can the systems approach of managed change be applied to education? Are systems engineers the best persons to undertake this? Should we select, modify and develop techniques particularly suited to education and should this be an inter-disciplinary team project?

The systems approach could result in a formalization of experiences which have worked in the past -- a formalized statement of steps leading to goals now outmoded. Or again it may provide alternate paths and allow for innovation.

Systems approaches actively provide for feedback and are self-adjusting. The systems approach may be defined as "the structure or organization of an orderly whole, clearly showing the inter-relations of the parts to each other and to the whole itself".

The new library will continue as a repository of accumulated knowledge but become the disseminator of materials and a dynamic storehouse housing non-computerized instruction machines and text stores plus readers. To what extent will books be replaced by magnetic or film tapes, microfilm, etc.? Will projection or display consoles in the home be connected to library storage files?

Machines in the library can provide for cataloguing, storing, anticipating needs, searching for information, answering questions and providing files and documents. This appears most useful for individual study.

Technological engineers concerned with library storage may use one of three methods: (1) use solid devices for storage and retrieval; (2) store information on microscopic transparencies (microfiche, etc.) using readers or print-out machines; (3) propel conventional books, pamphlets and such back and forth by means of a network of pneumatic tubes.

The newer media should not and will not be introduced into the school without the cooperation of the teachers. Appeals to teachers may be made to considered laziness, ingenuity, self-interest. They may also relate to the acquisition of technical competence and greater opportunity for using a professional approach. The use of machines and semi-professional help could cut non-professional routine activity by teachers and improve their teaching activity. Administration should ensure that the introduction of any newer media is done so as to be professionally beneficial to teachers.

Why should administrators become interested in innovation rather than the successful operation of an established system? It must be a challenge to them and they must be prepared to accept the risk.

Society too has a contribution to make in establishing new and closer relationships with the schools and ensuring a new role for education compatible with recognized needs of society and the individual. The social demands for education rose from the desire for primary education for all to secondary education and now for post-secondary or higher education. Our concern here is whether newer techniques and methods can enable larger numbers to accomplish this, as well as providing for adults to increase their educational and vocational competence.

In the work-a-day world employers have not done a good job of personnel selection, upgrading, rehabilitation or training, although considerable improvement has occurred in training and upgrading during the past decade. Seldom is personnel selection conducted scientifically. As a result, the amount of maladjustment among employees is considerable if you count underemployment, overemployment, etc.

Manpower needs will of necessity directly and indirectly affect the school offering. They also affect the likelihood of attracting a high percentage of the more able students to the education industry as teachers, administrators or research personnel. How can we ensure that education does get a fair, if not a lion's share, of able students?

Society contributes traditions, values and goals. In various ways it determines the social demand for education according to the premium it places on economic goods, social position, and the prestige it places on various occupations. This congeries of wants, drives and acquired needs affects the climate concerning the acceptance of education, attitude to innovation in education, and expectations from education. Technological advances have disrupted the former equilibrium and nothing short of a radical reorganization of relationships will ensure the degree of stability formerly experienced; and these must take count of new and changing social values, a new economic milieu, and world-wide changes and developments.

One basic problem is that of having innovations in education accepted. Opposing change are: social intertia, vested interests in maintaining the status quo, and struggles to maintain security. Changes cannot be introduced without disturbing the current situation and seldom without overcoming opposition.

Input of the education enterprise are pupils, teachers, materials and buildings, of which only pupils are generally not in short supply. The process is concerned with effecting changes in behavior, maintaining quality control or standards. Operations include scheduling, determining content, considering the introducing of new technology and keeping costs to a reasonable figure. The output is the schooled graduate. There is need for evaluation throughout, but particularly considering the values added to the input as determined from the benefits derived by society.

Today there are over 25,000 computers (over 2000 in Canada) at work performing over 700 functions. In education they are used for records of teachers, achievement, schools, equipment supplies, etc., and provide random access to the files and records.

They can provide education data banks; could accumulate ten or twenty years' records of total school populations for research and decision-taking.

Computer systems can integrate video tape recorders, micro image equipment, the talking typewriter and other equipment.

More particularly the computer is used for: (1) record keeping; (2) establishing a data bank; (3) student testing and evaluation; (4) information storage and retrieval; (5) programmed instruction; (6) simulation, problem solving, and higher process thinking; (7) time-sharing language systems.

Will computer systems be too costly to set up and maintain?

This new technique appears to provide a rapid, individualized flexible teaching tool. But it has many pitfalls ranging from limiting it to processing linear programs from teaching machines, to producing a labyrinth of data like a tropical jungle, not to mention problems of scheduling, costs, etc.

In industry it seems possible to train candidates as needed to a consistent, high level of skill with relatively few failures and lower qualifications.

Training programs can be prepared for technicians, clerical personnel, programmers, salesmen, professionals and managers. They can be used in pre-service, in-service, classroom, and special training for groups or individuals.

Some Questions Related to the Practicability of Introducing New Technology Into Education

1. What sort of administrative, consultative and evaluative organization could be recommended for the provincial departments and school and college units to be responsible for planning, administration and introducing change in our education systems? Is there need for a consultative body to determine perimeter and prepare guide lines to prevent undue waste, increase efficiency and prevent backsliding?

2. What help can be provided in creating new materials and selecting training materials from the increasing bulk of materials becoming available?

3. How do we set up a central file of on-going research, research findings and data banks? Do we need a cross-reference file of computer programs, software programs, education films, microfiche, etc., with data on their quality, approved application, etc. and a file of expert consultants?

4. Is there need for established channels of communication to acquaint education personnel with what is available or should it be left to news media, trade journals, government publications, committee reports, professional journals and such?

5. Instructional materials and devices supplied by industry should be scrutinized carefully. But by whom? Do we need a special body to do this?

6. Will computer systems be too costly to set up and maintain for regular instruction? Will they be too unreliable?

7. Can machine instruction adapt well enough to meet the needs of the individual student?

8. A computer may cost $1,200,000, more or less, depending on model and related machines; software could range from $7,000,000 to $10,000,000 for one system.

9. For what size of school will complex machine systems be practical?

10. Where is the money to come from? Local taxes are about as high as will be accepted, provincial funds are limited and uneven; federal funds therefore appear to be the main source. What should industry contribute directly? (The U.S. central government plus private industry will be footing much of the bill in the United States.)

11. Can computer-assisted instruction be introduced gradually? Could we begin with each pupil having access to a terminal station or cubicle for one hour per day? Can a school board start in a relatively small way? A computer plus single typewriter can be used for records, etc., plus the beginning of a full-blown system. Cost can be allocated to administration rather than instruction.

12. Because software costs are tremendously high, can costs be kept down by uniform curricula in some subjects? For example, is chemistry, medicine, mech. technology, etc., uniform enough in all countries for programmed units in the mother tongue to serve the purpose?

13. Can the answer to helping improve backward areas and helping deprived children come in part from the new technology?

14. Will the chief benefit from newer media be for out-of-school education, for example, in industry, the armed services, and for the "slow learners"; or does this just represent a stage in development of the newer media?

15. What will be the problems of copyright and "censorship"? No longer will there be a simple relationship between book publisher and teacher. The preparation of a multi-media system of instruction is tremendously costly and complex. Who is to determine which programs are acceptable?

16. Who will determine what software will be prepared? Will the approach be systematic, or scattered as determined by industry or individual researchers?

17. Can individual instruction and individual timetables be administered?

18. Who should have access to records available by random access to the computer?

19. What models can be recommended for the introduction of the newer media? Do they provide for R & D and planning?

20. What sort of timetabling will be necessary if automated education and greater use of other instructional media are introduced? Will we have individual timetabling, group timetabling, class timetabling or some combination of these? Will variable time units be used and variable grouping? Will timetabling cover part-time staff, community-society involvement, extended days and such?

21. In how far is a systems approach appropriate to an organization where input-output measurement is difficult, if not impossible?

22. Can we educate people out of poverty situations? We know education affects drive, aspirations, size of family, income, but may not know how to really change the situation.

23. What are some of the practical considerations -- cost (initial expenditure, continuing cost, upkeep and repairs, replacement, etc.), convenience, where used (home, school, plant, etc.), application (limited or general), attitude of teachers, students and others to it, efficiency compared with other methods, etc.?

24. Can the newer technology contribute to the decision-making process of school administration? Is there a data bank from Research results worth tapping? Does a gap exist between researcher and user? Where does one find relevant data related to studying, managing and administering large-scale activities?

25. What is the situation regarding planning in school units or other educational institutions? Can the new techniques and approaches contribute to planning?

26. Has the educational establishment sophisticated learning techniques which are readily available but are not being used?

R & D AND THE NEW TECHNOLOGY

Education could be organized as a more closely knit system with planning: to avoid crises; to increase efficiency; and to bring greater satisfaction. R & D activities could help provide direction, evaluate degree of success, test plans of action and help ensure rational progress. But this cannot be hoped for at present, in part because of inadequate research personnel and resources. Decisions cannot be withheld pending field tests. If we are to get away from panic decisions we must foresee needs and make necessary changes. The dynamics of educational change are not too well understood, but it is assumed that change and improvement can be made rational, an integral part of the developmental growth of institutions.

There is need for agreement on aims; need to coordinate research and development; need to direct much applied research endeavour; to set up research priorities and to develop new tools for evaluation.

Some believe that R & D can contribute most if directed towards developing new knowledge and new techniques to ensure that tomorrow's youth will have the education they need. Solving today's problems and analysis of yesterday's mistakes would come second and third.

Today's education developments are moving in the direction of meeting society's changing needs. There are two main trends, the first directed towards instruction on an individualized basis. The second, discipline-centered rather than child- or society-centered, is concerned with the organization of content. It is marked by an updating and reconstruction of content, a reorganization of subject matter, and some fresh methodological approaches. There is new emphasis on principles rather than parts, on learning through problem-solving rather than by precept, and on greater appreciation of individual differences. The introduction of newer media must be meshed with these movements.

The U.S.S.R. is conducting research related to technology in pedagogy, psychology, cybernetics, mathematical logic, statistics, theory of probability, and computer techniques. They have found that through combining programmed instruction with other instruction methods, there is improvement in activities and effectiveness. It permits the scientific organization of both the teachers' and pupils' work and results in better prepared personnel.

In 1964 at an annual exhibition in Moscow 300 different types of technical mechanisms were displayed, of which more than one-third were located in higher educational institutions.

If R & D is going to be integrated fully into education it is necessary to determine what research should be undertaken; to decide what part of this should be undertaken by education researchers, what parts should be done co-operatively with other disciplines and what should be done by members of other disciplines. The development and introduction of newer media in the schools, for example, will require research by industry and the schools and will be undertaken by engineers, communication experts, educators, sociologists, etc.

Education at present employs less than a handful of full-time researchers, a fair number of part-time researchers in the new institutes with light teaching loads; and college teachers, most of whom have heavy teaching loads or administrative responsibilities. Elsewhere the number with full or part-time free for research is limited.

Other limitations in addition to a paucity of researchers, include the lack of money readily available for research, the lack of organization to undertake research projects and provision for rapid communication of research findings. Research personnel could not attempt to find solutions to all available problems. It is therefore necessary to establish priorities and ensure concerted action.

Vocational guidance may consist of matching the characteristics of the individual with job requirements. The process consists of determining personal characteristics, i.e. abilities, aptitudes, personality traits, experience from tests, records, etc. Second, obtaining job information by job analysis, expert opinions, job description, etc. Counselling may consist of having the individual reach a decision.

To what extent can the computer assist in this? Using typewriter, earphones, television screen and referring students to various sources it may select, score and report on any test, compare students' marks with age or grade norms, compare score in one area with scores in others, show strengths and weaknesses, etc.

There is need for more work on (1) the objectives of learning, (2) abilities, interests and backgrounds students bring to school, (3) the encouragement or discouragement of school learning by home, school, society and attitudes of friends and associates, and (4) the extent to which new media have been incorporated and found to be reasonably effective.

More particularly there is need for research in the following and other areas: learning theory; communication theory; the development of instructional materials; techniques and systems; the incorporation of instructional materials into the education process; the evaluation of the educational process; the identification of education research needs and relevant findings regarding improved instruction; the applicability of instructional materials to formal school education and formal education outside the schools in industry, etc.; the identification of sources of financial support and establishment of units to undertake research tasks where there are none available.

The adoption of a systems approach in education would necessitate the careful specification of learning objectives in behavioral form, followed by evaluation and revision cycles. Selected groups could be used and the exercise continued until quality materials were obtained.

Some Challenging Areas for Research, Related More or Less Directly to the New Technology

1. Research concerning the nature of perception, organizing and assimilation of information, or more generally on learning, recalling and information handling.

2. The development of quantitative criteria for evaluating the effectiveness of assimilated knowledge, the mastery of subject matter and the development of creative behavior.

3. The experimental verification of effectiveness of the newer media.

4. Improvement in the coordination of pure and applied research through new methodology and experimental models.

5. The organization of a network of education institutes, education laboratories, field stations, experimental schools and demonstration centres.

6. The organization of R & D in school units and other education institutions.

7. The conduct of experimental projects on cybernetic devices answering to voice commands.

8. Work on programmed instruction, its theory, methods and the development of better programs, at all levels and in all areas, whether or not related to the computer.

9. The development of centres for research related to pre-service and on-the-job training.

10. Exploration to determine more effective uses of the new media in vocational and education guidance and counselling, linking students, the counsellor and the computer.

11. The creation of associations, committees or task forces interested in education and the new technology.

12. Research on the development of normal skills, e.g. equivalent response learning. Keyboard operators have been trained on the conditioned reflex principle with a minimum of intellectual activity and erroneous response, trial and error learning, and the use of the systems approach.

13. The development of remedial materials to cut down "wastage" and increase the number of graduates. Students may be branched from regular to remedial materials. Critical elements here may require differences in design and different learning reinforcement procedures.

14. Research on optimal use of available media including: conventional texts, programmed texts, machine-presented programs, films, film strips, video and audio tapes, education television, remote sources by dial, and computer systems.

15. Research endeavour at all levels and for all types of institutions and for on-the-job training.

16. Research to improve standard products and usage techniques.

17. Research on evaluation procedures.

18. Research on a new role for the teacher, utilizing the new media.

19. Determining how the new technology can contribute to creativity in education.

20. Determining the effects of the new technology on teacher education.

21. Systematic analysis of student learning behavior for the testing and revision of commercially available texts and instruction packages.

22. Ways of coupling software and communication. This could overcome isolation, cut costs, but will introduce new management problems.

23. R & D might provide a well-stocked storehouse of tested educational alternatives and put the "seal of approval" on methods or units found to be effective.

24. Determining what research should be scheduled and by whom, controlled and by whom.

25. How can we get greater benefit from the students in graduate programs in education?

26. How should grant sources be made available? Who should determine recipients and approve projects? How can the present funds made available for research be increased? What is the share of the provincial governments, the federal government, industry and foundations?

27. How can the work of researchers from various disciplines be coordinated?

28. What can research contribute to setting standards? What are the relative merits of teacher's assessment, year's work, final examinations, standardized achievement tests, university entrance examinations and aptitude tests?

29. Should we establish priorities for research projects related to the new media and, if so, how can these be selected?

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Formal Education -- The systematic development and cultivation of the natural powers by inculcation, stimulation, and example through instruction and training in institutions of learning.

Technology -- Theoretical knowledge of industry and the industrial arts and the application of science to the arts.

Symposium -- A meeting for discussion, bringing together comments and opinions; in ancient times characterized by the drinking of wine mixed with water and intellectual or entertaining conversation.

APPENDIX II

LIST OF SYMPOSIUM PARTICIPANTS/ PARTICIPANTS A LA COLLOQUE

Abbey, Dr. David, OISE
Anderson, Dr. R.N., Sask. U.
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Billowes, Mr. C.A., Northern Electric
Brahan, Mr. J., NRC
Brown, Mr. W.C., NRC
Byrne, Dr. T.C., Deputy Minister, Alta.
Campsie, Mr. J.S., J.M. Dent
Chapman, Mr. S.L., York Cen.High Sc.Bd.
Channon, Miss Geraldine, CTF
Clee, Prof. D., U. of Toronto
Cossette, Miss Jeannine, Chicoutimi
Crawford, Dr. D.H., Queen's U.
Darnell, Mr. Wm., McGraw Hill
Fritz, Dr. J., Calgary U.
Frohloff, Mr. E.C., Bell Telephone
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Gorrill, Mr. B., Encyclopedia Brit.
Gregoire, Mr. G.A., Fed. Coll. Classiques
Gwilliam, Dr. R.B., Manpower & Imm.
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Hart, Mr. J., OPARU
Harvey, Mr. N.G., Man.Dept. of Ed.
Hunt, Mr. P.B., Prentice Hall
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Lucow, Dr. W., DBS
Luther, J., Coll. of Ed., Tor.
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McLaren, Mr. Don, Air Canada
Marineau, Mr. René, CCRE
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